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May 22, 2015

Ms. Rebecca Chu
U.S. Environmental Protection Agency, Region 10
1200 Sixth Avenue
Seattle, Washington 98101

BY E-MAIL ONLY

RE: RESPONSE TO EPA COMMENTS ON THE NOVEMBER 20, 2014 REVISED DRAFT ADDENDUM TO THE OPERATIONS, MONITORING, AND MAINTENANCE PLAN, BASIS OF DESIGN REPORT
JORGENSEN FORGE EARLY ACTION AREA REMOVAL ACTION
SEATTLE, WASHINGTON
U.S. EPA DOCKET NO. CERCLA-10-2013-0032
FARALLON PN: 831-032

Dear Ms. Chu:

Farallon Consulting, L.L.C. (Farallon) has prepared this letter on behalf of Earle M. Jorgensen Company (EMJ) to provide responses to comments from the U.S. Environmental Protection Agency (EPA) dated March 11, 2015 (Attachment A) on the memorandum regarding Revised Draft Addendum to the Operations, Monitoring, and Maintenance Plan, Basis of Design Report – Jorgensen Forge Early Action Area dated November 20, 2014, prepared by Farallon. This letter provides responses to each of the EPA comments based on follow-up communications and meetings with EPA. EPA comments are provided in **bold**, followed by Farallon responses in *italics*. The updated Addendum No. 1 to the Operations, Monitoring, and Maintenance Plan, Basis of Design Report – Jorgensen Forge Early Action Area Removal Action dated May 22, 2015 (herein referred to as the OMMP Addendum) is included in Attachment B.

EPA COMMENTS - MARCH 11, 2015

PURPOSE OF THE GROUNDWATER AND STORMWATER MONITORING

Comment 1

The Addendum must be revised to include reference to the Action Memorandum as the basis for defining the stormwater and groundwater Sampling and Analysis Plans (SAPs) objectives. The Action Memorandum identifies stormwater and groundwater pathways in defining removal action objectives (RAOs), removal action requirements and long-term monitoring requirements.

Response: Farallon updated Sections 1.0 and 2.0 of OMMP Addendum No. 1 to include reference to the Action Memorandum and to state the requirements and objectives for the removal action based on the Action Memorandum.

Comment 2

The Addendum must also include a Project Schedule for performing the stormwater and groundwater monitoring, including the performance of the ''baseline" conditions as necessary for the long-term OMMP. Under the Settlement Agreement and SOW, EMJ is also required to ensure that it's Health and Safety Plan is adequate for groundwater and stormwater monitoring activities. The revised Addendum should reference to those sections of the Health and Safety Plan that pertain to the activities described in the Addendum.

Response: Farallon included a Project Schedule as Table 1 in Section 2.0 of the OMMP Addendum No. 1. Farallon also included in Section 3.0, and Tables 2, 3, and 4, an explanation of the performance "baseline" conditions at the Site. The Health and Safety Plan provided as Appendix A is adequate for groundwater and stormwater monitoring activities as well as groundwater monitoring well installation and soil sampling. Reference to the Health and Safety Plan was included in each of the sections that describe field work activities in OMMP Addendum No. 1 (Sections 5.0, 5.1, 6.1, 7.1, and 8.1).

GROUNDWATER MONITORING WELL INSTALLATION

Comment 3

The Addendum must include a Work Plan for Groundwater Monitoring Well Installation. The Work Plan must include sampling soils for the Removal Action's Contaminants of Concern (COCs) during the monitoring well construction. The Addendum must also be revised to include appropriate methodologies for detecting whether COCs are encountered during groundwater monitoring well installation, in addition to those methodologies already described in the Addendum. The Addendum identifies that a geologist will observe subsurface conditions and record information on the boring logs, including the soil types encountered, visual and olfactory evidence of contaminant presence, and volatile organic vapor concentration as measured using a photo ionization detector. None of the described methodologies are appropriate for detecting the COCs at the Site.

Response: Farallon updated OMMP Addendum No. 1 to include in Section 5.0, a description of groundwater monitoring well installation and soil sampling procedures. During the March 26, 2015 technical meeting with EPA, Farallon and EPA agreed to a tiered approach, in which soil samples would be collected and archived, and analyzed only if constituents of concern (i.e., polychlorinated biphenyls and metals) were detected at concentrations exceeding screening level values in groundwater. Farallon added an explanation in Section 5.0 of OMMP Addendum No. 1 that Farallon uses the specified soil contamination detection methods as standard procedure when advancing soil borings. The soil samples will serve as the main means for detecting COCs in soil. Soil samples will be archived at the laboratory and analyzed only if any of the COCs exceed screening levels in groundwater samples. Only the soils samples from monitoring wells that had groundwater exceedances will be analyzed and only the COCs detected in groundwater will be analyzed for in the soil samples.

Comment 4

During the Non-Time Critical Removal Action (NTCRA) within the EMJ removal action boundary (RAB) this past summer, pilings and unanticipated fill were encountered during the bank work. In light of this, the Addendum must be revised to include further detail within the groundwater monitoring well Work Plan that describes what the anticipated geology will be when constructing the monitoring well and what contingencies will be employed in the event unanticipated fill material is encountered during the construction of the well. Because the Addendum specifies using an auger rig for boring the groundwater monitoring well, the Work Plan must also provide for a standard penetration test to be performed prior to the auger boring to allow for a more detailed geological description of the stratigraphy where the sampling well is to be constructed.

Response: Farallon updated Section 5.0 of OMMP Addendum No. 1 to include an explanation of the contingency actions to be employed if unanticipated fill or obstructions are encountered during monitoring well installation. Farallon also included in Section 5 the explanation prior to boring, a standard penetration test will be conducted at each location where a well will be constructed.

Comment 5

The Addendum must include sufficient detail regarding the EMJ well installation compared to the suggested practices of the pertinent EPA handbook. EPA has established technical guidance for designing and installing monitoring wells: "Handbook for Suggested Practices for Design and Installation of Monitoring Wells", EPA 600/4-89/034.

Response: Farallon updated Section 5.0 of OMMP Addendum No. 1 to include reference and detail related to monitoring well installation per the EPA "Handbook for Suggested Practices for Design and Installation of Monitoring Wells" 600/4-89/034.

Comment 6

The Addendum must define criteria for assessing whether the monitoring wells are developed appropriately. For example, the current language notes that turbidity of purge water will be observed and recorded, but does not specify acceptable NTUs that must be met.

Response: Farallon updated Section 5.0 of OMMP Addendum No. 1 to include more-detailed criteria for assessing whether the monitoring wells are developed appropriately, including specifying that wells will be purged until ≤25 nephelometric turbidity units is attained. Farallon also provided Farallon's standard operating procedures for well development in Appendix B Section 2.

Comment 7

The Addendum must also include a Health and Safety Plan for the Groundwater Monitoring Well Installation, as required under the SOW and Settlement Agreement.

Response: Farallon included a Health and Safety Plan that includes groundwater monitoring well installation, as Appendix A to OMMP Addendum No. 1.

GROUNDWATER SAMPLING AND MONITORING

Comment 8

Generally, the Addendum must be revised to describe how the groundwater Sampling and Analysis Plan (SAP) is designed to meet this RAO. This must include greater detail in the Addendum of the groundwater pathway associated with the sediments within the EMJ RAB. This should include information about the conceptual Site model related to groundwater; the hydraulic parameters and groundwater flow pattern of the groundwater system from the Jorgensen Forge facility to the EMJ RAB sediments; the nature and extent of contaminants of concern associated with the groundwater pathway; and an evaluation of the known or suspected migratory pathways from groundwater to the sediments within the EMJ RAB.

Similarly, the groundwater SAP must be revised to include a description of how the Field Sampling Plan (FSP) is designed to collect groundwater data used in assessing the groundwater to sediment pathway. This must include a description of the monitoring well network in relation to the sediments within the EMJ RAB, and identify how the groundwater monitoring data will be used to determine the total mass loading of groundwater contaminants into the sediments. The Addendum must ensure that the locations and construction (screened intervals) of the shoreline monitoring wells define the spatial distribution of current or future groundwater contamination of the EMJ RAB sediments from the groundwater pathway. The Addendum must provide greater description of the proposed monitoring plan to ensure that the sampling frequency and duration adequately represent temporal trends of any groundwater contamination to the EMJ RAB sediments.

Under the current OMMP, none of the long-term sediment sampling locations are designed to assess potential groundwater sources. The revised Addendum must describe sediment samples that will be used to assess if the groundwater is the source of contamination when an exceedance of the removal action level (RvAL) is observed in sediments within the EMJ RAB.

Response: Farallon updated Section 3.0 of OMMP Addendum No. 1 with information: 1) detailing how the groundwater sampling is designed to meet the removal action objectives; 2) related to the groundwater conceptual site model including groundwater flow, parameters, nature and extent, and the suspected groundwater to sediment pathway; and 3) providing greater detail on the monitoring well network in relation to sediment within the EMJ RAB and regarding *the proposed monitoring plan. As explained in Section 6.0 of OMMP Addendum No. 1, sediment samples collected from sample locations LTR-1, LTR-2, and LTR-5 will be used to assess potential groundwater sources.*

Comment 9

In addition to defining how the FSP is designed to assess both groundwater COC concentrations and the groundwater to sediment pathway, the Addendum must be revised to include appropriate groundwater screening levels for assessing the COCs in groundwater as compared to the RvALs for the NTCRA. The RvALs are expressed as sediment concentrations (mg/kg). In the current version of the revised draft Addendum, the groundwater screening level values, provided in Exhibit D, are expressed water concentrations (µg/L), with no basis relating the water column concentrations to the RvAL sediment concentrations. The only reference cited supporting the groundwater screening levels as appropriate appears as a footnote in Exhibit D to the "SQS Protective Groundwater Screening Level." The footnote identifies a report generated for the Washington State Department of Ecology, entitled "Draft Source Control Action Plan- Slip Duwamish Waterway'', prepared by SAIC, February, 2007. However, a review of Washington State Department of Ecology's plans finds no draft document by that name.

Similarly, Washington State Department of Ecology staff have no knowledge of the referenced report.

The Addendum must include a technical basis for comparing the groundwater screening levels to the RvALs associated with the NTCRA and establishing when recontamination is occurring due to groundwater sources. Additionally, the Groundwater Screening Levels must be included in the main body of the Addendum text.

Response: Farallon included a description of the rationale for the screening levels selected for soil, groundwater, stormwater, and solids in Section 4.0 of OMMP Addendum No. 1. The screening levels used for soil, groundwater, stormwater, and solids are provided in text in Section 4.0. The footnote titled "Draft Source Control Action Plan-Slip Duwamish Waterway" was removed from Table 5.

Comment 10

The groundwater FSP for the Addendum must include a description of any considerations made in the sample handling to address collecting, storing and analyzing groundwater samples that originate from anoxic conditions vs. aerobic conditions. Studies have demonstrated that degassing (loss of carbon dioxide) and oxygenation (and result losses of iron and trace metals) can affect analytical results for water quality constituents at the parts per million level. The extent to which the results for these water quality parameters are sensitive to sampling procedures is a function of the major ion chemistry and chemical speciation. Therefore, complete mineral analyses should be included in most sampling programs, if only on a limited basis.

Response: Farallon spoke with Ms. Chu on May 1, 2015. Farallon and EPA came to the consensus that Farallon will perform the sampling in accordance with EPA low-flow sampling procedures, and no additional sampling requirements are necessary.

Comment 11

The Addendum must include decision rules and contingency response actions if the monitoring results exceed the screening level criteria and/or indicate that groundwater is recontaminating the sediments within the EMJ RAB. While a contingency plan is identified in Section 6.2 of the OMMP (Appendix F of the Basis of Design Report), it does not include enough detail specific to the groundwater pathway. The Addendum must include a more detailed contingency plan where the groundwater screening level criteria are exceeded and/or where groundwater may be the source of recontamination of the sediments within the EMJ RAB. The Addendum must provide a basis explaining how the contingency plan aligns with the requirements of the Action Memorandum specific to assessing the groundwater to sediment pathway and assessing effectiveness of source control (described previously in this letter).

Response: Farallon included in the Reporting Sections 9.2.2, 9.2.4, and 9.2.6 in OMMP Addendum No. 1 to outline contingency rules for groundwater, stormwater, and solids sampling, respectively. Farallon also included text in Sections 9.2.2, 9.2.4, and 9.2.6 to explain how the contingency plan aligns with the requirements of the Action Memorandum.

STORMWATER SAMPLING AND MONITORING

Comment 12

The Addendum must be revised to describe how the stormwater SAP is designed to meet the above objective identified in the Action Memorandum. These revisions must include greater detail of Jorgensen Forge Facility's stormwater management system, including: a conceptual site model specific to the storm water as a pathway to the sediments within the EMJ RAB; the total acreage of storm water that drains in to the stormwater system; the maximum capacity of the stormwater treatment system; details of how stormwater that exceeds the treatment system's capacity is handled/managed; any known history of cleaning of the storm water system that has occurred (e.g. line cleaning); how the storm water system is maintained; and any information regarding base flows from groundwater infiltrating the stormwater system in addition to stormwater.

Response: Farallon updated Section 7.0 of OMMP Addendum No. 1 to include the requested information regarding the stormwater management system.

Comment 13

The Addendum must be revised to include a detailed description of how the stormwater SAP is designed to fully characterize the stormwater effluent being discharged in to the EMJ RAB. The current Addendum is not designed to fully characterize the stormwater

effluent, does not include characterization of the receiving water for comparison to the storm water effluent, and does not correlate the storm water SAP data to sediment concentrations of COCs within the EMJ RAB.

In order to fully characterize the storm water effluent being discharged in to the EMJ RAB, EPA requires the following additional revisions be included in the Addendum:

- **Monitoring for solids within the stormwater SAP. Because the stormwater sampling objective is specific to recontamination from the stormwater pathway to the sediments within the RA B, EMJ is required to include sampling for solids within the storm water system, in addition to whole water. Sampling for whole water and sediments will provide a more complete characterization of the effluent being discharged into the RAB, and is consistent with other LDW Early Action Areas. For example, the North Boeing Field SAP for the long term storm water treatment system includes the collection of filtered solids and flow weighted composite sampling for its treated effluent to characterize potential contaminated sediments being discharged on to the LDW Superfund site.**

Response: Farallon updated OMMP Addendum No. 1 to include monitoring for solids, described in Section 8.0.

- **Flow data within the stormwater SAP. Flow data will verify volume estimates and track changes over time that do not appear to be the result of storm events. Flow data will also identify any potential base flow that may be occurring at the Site. Where an estimated volume used, the Addendum must specify the method to be used for deriving flow estimation.**

Response: Farallon updated Section 7.1 of OMMP Addendum No. 1 to state that flow data will be monitored as part of the quarterly stormwater monitoring activities.

- **A technical basis within the storm water SAP describing how the frequency of monitoring will provide representative data that characterizes the stormwater effluent being discharged to the EMJ RAB. In reviewing the current revised draft Addendum, there is no technical justification of how the current monitoring frequency ensures providing representative data to characterize the discharge from the storm water outfall. EPA recommends EMJ utilize a tiered approach for monitoring, with more frequent monitoring over the first year (monthly) in addition to sampling a sufficient number of storm events. Using a tiered approach, EMJ could then propose scaling back the extent of monitoring depending on the results from the first year of monitoring data.**

Response: Farallon updated OMMP Addendum No. 1 to include a tiered approach for stormwater monitoring. Monitoring will occur quarterly for the first year, and then will be scaled back to semiannually based on first-year stormwater sampling results, as described in

Section 7.0. Jorgensen Forge is monitoring stormwater monthly in accordance with their NPDES permit. Monthly NPDES permit monitoring data in conjunction with EMJ quarterly sampling data is the technical justification for the quarterly stormwater sampling frequency included in the OMMP Addendum No. 1 and is sufficient to characterize stormwater effluent.

- **A technical basis describing the number of samples and sample volumes that will be collected based on the number of constituents that will be analyzed. These calculations must also be revised to include samples of solids from the effluent. This information is currently missing in the main text of the document.**

Response: Farallon updated Table 4 of the QAPP to include the number of samples and sample volumes for each of the constituents that will be analyzed for, including for solids. Table 4 of the QAPP is included in text in Section 5.1

- **A technical basis supporting the stormwater SAP sample collection timing and methodology to ensure it effectively characterizes the effluent discharge to the EMJ RAB. For example, the current Addendum states that stormwater samples will be collected within the first 12 hours of stormwater discharge, but provides no technical basis as to how this timeframe ensures that the data collected are representative of the effluent. Additionally, the citation date for Ecology's sampling guidance How To Do Stormwater Sampling- A Guide to Industrial Facilities is incorrect and must be revised.**

Response: Farallon updated Section 7.1 of OMMP Addendum No. 1 to include the basis for collecting stormwater samples within 12 hours of a stormwater event, and how sample collection during that time frame ensures that the data are representative of the effluent. The samples will be collected from the NPDES stormwater sampling effluent port, located down-gradient of the treatment system. The Ecology sampling guidance reference was corrected.

Comment 14

The Addendum must be revised to include a technical justification for the screening level criteria within the storm water SAP that relates to the objective of assessing recontamination of the sediments within the EMJ RAB. The current revised draft Addendum lacks any technical basis defining the relationship of the storm water screening level criteria, found in Exhibit D of the Addendum, to sediment concentrations RvALs that apply to the EMJ RAB.

The EPA provided the same requirement in its October 7, 2014 comment letter. While the current Addendum includes a discussion of screening levels, it still lacks a technical basis relating the proposed screening levels to assessing the sediment concentrations of COCs within the EMJ RAB. The screening level criteria, found in Exhibit D of the current revised draft Addendum, only utilize the marine surface water quality criteria developed to protect aquatic life. Furthermore- the table does not even include the sediment RvALs, which are the basis for assessing recontamination of the sediments within the EMJ RAB.

The revised stormwater screening level criteria must include the sediment RvALs. The table of screening level criteria must be inserted into the body of the Addendum within the stormwater SAP.

Response: A summary of the screening level values and the technical basis relating the screening levels to sediment concentrations within the removal action boundary based on pathways and the screening level values selected has been included in the text of Section 4.0 for soil, groundwater, stormwater, and solids. Farallon also updated Table 5 of OMMP Addendum No. 1 to include the sediment RvALs and included Table 5 in Section 7.0.

Comment 15

In its October 7, 2014 comment letter, the EPA also noted that EPA Method 8082 for detecting PCB is only appropriate if the laboratory used additional mechanisms to increase the sensitivity of the methodology:

> **EMJ must revise the analytical methodology used to achieve more sensitive detection limits for PCBs. Method 8082 is only appropriate if the selected lab utilizes the options within the methodology that allow for more sensitive detection limits. Utilizing options provided within Method 8082 to achieve a more sensitive detection limit is consistent with PCB monitoring of stormwater at surrounding Early Action Areas (EAAs) on the LDW. For example, at the Slip 4 EAA, the selected laboratory, ARI, utilizes a larger sample volume and a different solvent to attain more sensitive minimum detection limits. At T-117, the City of Seattle is, similarly, proposing to utilize the options identified in the Method 8082 documents to achieve a detection limit that is more sensitive. EMJ is required to do the same.**

It is still unclear within the current revised draft Addendum if EMJ made the necessary revisions to address this comment. The Addendum must be revised and confirm that EMJ intends to revise the analytical methodology used to achieve the more sensitive detection limit for PCBs.

Response: Farallon updated Table 4 of the QAPP to include sample volume and preservative types. To achieve the lower limits of quantitation for PCBs using EPA Method 8082, Farallon is collecting one liter of water for each stormwater and groundwater sample, which is twice the standard volume. ARI will use hexane solvent for extraction.

Comment 16

The Addendum must be revised to include a technical basis describing how the stormwater SAP aligns with the long-term sediment monitoring plan defined in the OMMP; and how surface sediment data will be used to assess if recontamination is occurring due to the storm water pathway. The BODR intended to collect sediment sampling data within the EMJ RAB for the purposes of monitoring storm water effluent impacts. The OMMP within the BODR includes one surface sediment sample location that was intended to align with

the discharge area of stormwater from the Jorgensen Forge Facility. However, that location was based on a proposed outfall that was to be constructed as part of the NTCRA, which did not occur:

> **A sixth sediment sample (LTR-4) is specifically located to monitoring potential sediment quality impacts from the discharge area of the new outfall that will be constructed during the removal action. Surface sediment samples collected within the RAB will be submitted for chemical analysis for the chemicals of concern (COCs)...**

Because the new outfall was never constructed by Jorgensen Forge, there is no relationship between sediment sampling LTR-4 and the stormwater discharge point. Therefore, the EPA requires EMJ revise the location of LTR-4 to align with the existing stormwater discharge location of Outfall 3.

Response: OMMP Addendum No. 2 dated April 22, 2015 outlines the revised location of LTR-4, which now aligns with stormwater discharge from Outfall 003. The new location of LTR-4 is shown on Figure 1 of OMMP Addendum No. 1.

Comment 17

The Addendum for the stormwater SAP must be revised to include decision rules and contingency response actions if the monitoring results exceed the screening level criteria and/or indicate that stormwater is recontaminating the sediments within the EMJ RAB. While a contingency plan is identified in Section 6.2 of the OMMP (Appendix F of the BODR), it does not include enough detail specific to the stormwater pathway. The Addendum must provide a technical basis explaining how the contingency plan aligns with the requirements of the Action Memorandum in assessing the storm water to in-waterway sediment pathway and recontamination.

Response: Farallon included Sections 9.2.2, 9.2.4, and 9.2.6 in OMMP Addendum No. 1 to outline contingency rules for groundwater, stormwater, and solids sampling, respectively. Farallon also provided text in Sections 9.2.2, 9.2.4, and 9.2.6 to explain how the contingency plan aligns with the requirements of the Action Memorandum.

Comment 18

The stormwater SAP Addendum must include a revision to the naming convention for the stormwater sampling to reflect that the sample is not being pulled from Outfall 3, but instead from the stormwater collection vault.

Response: Farallon revised the stormwater sample-naming convention in Section 7.2 of OMMP Addendum No. 1 to reflect that the sample will be collected from the stormwater effluent sample port.

Comment 19

EMJ should consider the stormwater sampling plans of other Early Action Areas within the Lower Duwamish Waterway for examples of how stormwater sampling data can be used to evaluate in-water sediment concentrations. For example, at T-117, it has been proposed that surface sediment samples be taken around the outfall at the site. In the event any of those surface sediment samples exceed the PCB criterion of 12 mg/kg OC, then existing surface sediment data from surrounding areas will be obtained/reviewed to see if the SCO criterion is exceeded elsewhere. Spatial and temporal trends, along with Aroclor component analysis, will also be reviewed to gain insights regarding the causes of any exceedances near the outfall. Finally, storm drain solids data will be evaluated to assess its possible contribution to exceedances of the PCB criterion near the outfall.

Response: Farallon reviewed the T-117 screening levels and Boeing Plant 2 TMCLs and revised Table 5, and added information in Section 8.0 regarding how the solids data will be evaluated to assess possible contribution to sediments near Outfall 003.

SCHEDULING

Comment 20

The Addendum must include notifying EPA at least four weeks prior to scheduled monitoring events for the purpose of scheduling such activities to accommodate EPA participation, if requested.

Response: Farallon updated text in Section 6.0 of OMMP Addendum No. 1 to include that Farallon will notify EPA at least 4 weeks prior to monitoring events.

REPORT

Comment 21

The Addendum must specify that the groundwater and storm water reports provided to EPA include the data, data validation report, and evaluation.

Response: Farallon updated Section 9.2 of the OMMP Addendum No. 1 to include that data, data validation reports, and data evaluation will be included in the groundwater and stormwater monitoring reports.

QUALITY ASSURANCE PROJECT PLAN

Comment 22

The QAPP should identify Gina Grepo-Grove as the QA/QC Manager for EPA.

Response: Farallon revised Section 2.3 of the QAPP to identify Ms. Gina Grepo-Grove as the QA/QC Manager for EPA.

Comment 23

The QAPP identifies ARI as the lab performing the data analysis, while EcoChem will be performing the data analysis. The revised QAPP must define the stage when the data will be validated by EcoChem.

Response: Farallon updated Section 18.2 of the QAPP to state that data will be validated within 14 days of the review by the Farallon QA/QC Manager.

Comment 24

The QAPP does not identify what the Data Quality Objectives are for this project. The Addendum must be revised to include defined Data Quality Objectives, which should be included in the main body of the Addendum as well as the QAPP. As previously described, the objectives of these monitoring events must include references to the Action Memorandum requirements.

Response: Farallon updated Section 4.1 of the QAPP and Section 2 of the OMMP Addendum No. 1 to include detailed data quality objectives as outlined and referenced in the Action Memorandum.

Comment 25

EPA noted in its prior comment letter:

> **EPA's Forum on Environmental Measurement (FEM) requires the laboratory and field workers to demonstrate competency. This must include the training and qualifications of the personnel that will handle this project. This must also include the current accreditation/certification and QA Manual of the laboratory. The Addendum must be revised to include this information for all laboratory and field workers who will be performing the sampling and analysis of the groundwater and stormwater data.**

The information provided in Section 5 of the QAPP does not include sufficient detail. The revised Addendum should include greater detail related to this requirement.

Response: Farallon included Table 3 of the QAPP to outline personnel training and certifications. Farallon also included the laboratory accreditations/certifications as Attachment 1 of the QAPP.

Comment 26

Under Sampling Process Design, include a table that identifies the number of samples that will be collected at each location, detection limits, preservation requirements, sample locations (lat/long), volume of media collected for each analyte or procedure and a list of analyses matrix. The Addendum should include this in both the main text and the QAPP.

Response: Farallon revised Table 4 of the QAPP to include a list of the sample latitude/longitude location, number of samples to be collected, matrix, parameters, sample size, container size and type, holding times, preservation type, and limits of quantitation for the soil, groundwater, stormwater, and solids samples. Farallon included Table 4 of the QAPP in text in Section 7.0 of the QAPP and in text in Section 5.1 of OMMP Addendum No. 1.

Comment 27

Section 17.1 of the QAPP states that the laboratory will provide written details of any planned modifications to laboratory protocols for Farallon's review. The QAPP must be revised to include EPA review and approval in any modifications to laboratory protocols, in addition to Farallon's review.

Response: Farallon updated Section 17.1 of the QAPP to include EPA review and approval for any planned modifications to laboratory protocols.

Please contact the undersigned at (425) 295-0800 if you have questions or need additional information.

Sincerely,

Farallon Consulting, L.L.C.

Amy Essig Desai

Amy Essig Desai
Principal

Attachments: Attachment A,EPA Comments letter dated March 11, 2015
Attachment B, Addendum No. 1 to the OMMP, dated May 22, 2015

cc: E. Gilbert Leon, Earle M. Jorgensen Company, by e-mail
Miles Dyer, Jorgensen Forge Company, by e-mail
William Joyce and Ian Sutton, Joyce Ziker Parkinson, PLLC, by e-mail
Ryan Barth and David Templeton, Anchor QEA, by e-mail

AED:bjj

ATTACHMENT A
EPA COMMENTS LETTER DATED MARCH 11, 2015

RESPONSE TO EPA COMMENTS ON THE NOVEMBER 20, 2014 REVISED DRAFT ADDENDUM TO THE OPERATIONS, MONITORING, AND MAINTENANCE PLAN, BASIS OF DESIGN REPORT
Jorgensen Forge Early Action Area Removal Action
Seattle, Washington

Farallon PN: 831-032

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue, Suite 900
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OFFICE OF
ENVIRONMENTAL
CLEANUP

March 11, 2015

Mr. E. Gilbert Leon Jr.
Earle M. Jorgensen Company
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Lynwood, California 90262

Ms. Amy Essig Desai
Farallon Consulting, LLC
975 5th Ave Northwest
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Re: EPA Comments on the November 20, 2014 Revised Draft Addendum to the Operations, Monitoring and Maintenance Plan, Removal Design, Jorgensen Forge Early Action Area Removal Action, U.S. EPA Docket No. CERCLA 10-2013-0032

Dear Mr. Leon and Ms. Essig Desai:

On November 20, 2014, EPA received EMJ's revised draft Addendum to the Operations, Monitoring and Maintenance Plan (OMMP), Basis of Design Report (BODR), Jorgensen Forge Early Action Area Removal Action, U.S. EPA Docket No. CERCLA-10-2013-0032. EPA has reviewed the revised draft Addendum and is requiring further revisions as set forth below.

Purpose of the Groundwater and Stormwater Monitoring

The November 20, 2014 revised draft Addendum states that the purpose of the groundwater and stormwater monitoring is to:

> *. . . confirm that groundwater within the water-bearing zone of the EMJ Removal Action dredged sediments, and stormwater discharging from the Site do not contain concentrations of the metals arsenic, cadmium, chromium, copper, lead, mercury, silver, and zinc; and polychlorinated biphenyls (PCBs) that could result in recontamination of the shoreline bank and in-water sediments.*

The Addendum must be revised to include reference to the Action Memorandum as the basis for defining the stormwater and groundwater Sampling and Analysis Plans (SAPs) objectives. The Action Memorandum identifies stormwater and groundwater pathways in defining removal action objectives (RAOs), removal action requirements and long-term monitoring requirements.

The Action Memorandum identifies five RAOs, including one specific to groundwater and sediment protection:

> ***Groundwater and sediment protection***. *Reduce migration of contaminants in groundwater to sediments to reduce risk to human health and health and the environment.*

The Action Memorandum goes on to describe the removal action itself, which includes groundwater and stormwater sampling and monitoring under the Water Control System:

> *Baseline groundwater sampling monitoring, during and after removal action, is required to demonstrate that the bank action adequately removed contaminants which caused groundwater to exceed removal action levels. If groundwater exceedances persist, additional measures will be evaluated.*
>
> *Storm water must be monitored to ensure any water release to the LDW will not result in recontamination of sediments or harmful exposure to benthic organisms.*

Both the stormwater and groundwater are complete pathways identified as potential sources of recontamination to the Lower Duwamish Waterway from the Jorgensen Forge Facility. The Statement of Work (SOW), Appendix A of the Settlement Agreement, includes the following objective for the OMMP as it relates to sources:

> *Evaluate the effectiveness of source control and sediment removal.*

The Addendum must also include a Project Schedule for performing the stormwater and groundwater monitoring, including the performance of the "baseline" conditions as necessary for the long-term OMMP. Under the Settlement Agreement and SOW, EMJ is also required to ensure that its Health and Safety Plan is adequate for groundwater and stormwater monitoring activities. The revised Addendum should reference those sections of the Health and Safety Plan that pertain to the activities described in the Addendum.

<u>Groundwater Monitoring Well Installation</u>

The Addendum must include a Work Plan for Groundwater Monitoring Well Installation. The Work Plan must include sampling soils for the Removal Action's Contaminants of Concern (COCs) during the monitoring well construction. The Addendum must also be revised to include appropriate methodologies for detecting whether COCs are encountered during groundwater monitoring well installation, in addition to those methodologies already described in the Addendum. The Addendum identifies that a geologist will observe subsurface conditions and record information on the boring logs, including the soil types encountered, visual and olfactory evidence of contaminant presence, and volatile organic vapor concentration as measured using a photoionization detector. None of the described methodologies are appropriate for detecting the COCs at the Site.

During the Non-Time Critical Removal Action (NTCRA) within the EMJ removal action boundary (RAB) this past summer, pilings and unanticipated fill were encountered during the bank work. In light of this, the Addendum must be revised to include further detail within the groundwater monitoring well Work Plan that describes what the anticipated geology will be when constructing the monitoring well and what contingencies will be employed in the event unanticipated fill material is encountered during the construction of the well. Because the Addendum specifies using an auger rig for boring the groundwater monitoring well, the Work Plan must also provide for a standard penetration test to be performed prior to the auger boring to allow for a more detailed geological description of the stratigraphy where the sampling well is to be constructed.

The Addendum must include sufficient detail regarding the EMJ well installation compared to the suggested practices of the pertinent EPA handbook. EPA has established technical guidance for designing and installing monitoring wells: "Handbook for Suggested Practices for Design and Installation of Monitoring Wells", EPA 600/4-89/034.

The Addendum must define criteria for assessing whether the monitoring wells are developed appropriately. For example, the current language notes that turbidity of purge water will be observed and recorded, but does not specify acceptable NTUs that must be met.

The Addendum must also include a Health and Safety Plan for the Groundwater Monitoring Well Installation, as required under the SOW and Settlement Agreement.

Groundwater Sampling and Monitoring

As noted previously, groundwater and sediment protection is a specific RAO for the NTCRA:

> ***Groundwater and sediment protection***. *Reduce migration of contaminants in groundwater to sediments to reduce risk to human health and the environment.*

Generally, the Addendum must be revised to describe how the groundwater Sampling and Analysis Plan (SAP) is designed to meet this RAO. This must include greater detail in the Addendum of the groundwater pathway associated with the sediments within the EMJ RAB. This should include information about the conceptual Site model related to groundwater; the hydraulic parameters and groundwater flow pattern of the groundwater system from the Jorgensen Forge facility to the EMJ RAB sediments; the nature and extent of contaminants of concern associated with the groundwater pathway; and an evaluation of the known or suspected migratory pathways from groundwater to the sediments within the EMJ RAB.

Similarly, the groundwater SAP must be revised to include a description of how the Field Sampling Plan (FSP) is designed to collect groundwater data used in assessing the groundwater to sediment pathway. This must include a description of the monitoring well network in relation to the sediments within the EMJ RAB, and identify how the groundwater monitoring data will be used to determine the total mass loading of groundwater contaminants into the sediments. The Addendum must ensure that the locations and construction (screened intervals) of the shoreline monitoring wells define the spatial distribution of current or future groundwater contamination of the EMJ RAB sediments from the groundwater pathway. The Addendum must provide greater description of the proposed monitoring plan to ensure that the sampling frequency and duration adequately represent temporal trends of any groundwater contamination to the EMJ RAB sediments.

Under the current OMMP, none of the long-term sediment sampling locations are designed to assess potential groundwater sources. The revised Addendum must describe sediment samples that will be used to assess if the groundwater is the source of contamination when an exceedance of the removal action level (RvAL) is observed in sediments within the EMJ RAB.

In addition to defining how the FSP is designed to assess both groundwater COC concentrations and the groundwater to sediment pathway, the Addendum must be revised to include appropriate groundwater screening levels for assessing the COCs in groundwater as compared to the RvALs for the NTCRA. The RvALs are expressed as sediment concentrations (mg/kg). In the current version of the revised draft Addendum, the groundwater screening level values, provided in Exhibit D, are expressed water concentrations (μg/L), with no basis relating the water column concentrations to the RvAL sediment concentrations. The only reference cited supporting the groundwater screening levels as appropriate appears as a footnote in Exhibit D to the "SQS Protective Groundwater Screening Level." The footnote identifies a report generated for the Washington State Department of Ecology, entitled "Draft Source Control Action Plan- Slip Duwamish Waterway", prepared by SAIC, February, 2007. However, a review of Washington State Department of Ecology's plans finds no draft document by that name. Similarly, Washington State Department of Ecology staff have no knowledge of the referenced report.

The Addendum must include a technical basis for comparing the groundwater screening levels to the RvALs associated with the NTCRA and establishing when recontamination is occurring due to groundwater sources. Additionally, the Groundwater Screening Levels must be included in the main body of the Addendum text.

The groundwater FSP for the Addendum must include a description of any considerations made in the sample handling to address collecting, storing and analyzing groundwater samples that originate from anoxic conditions vs. aerobic conditions. Studies have demonstrated that degassing (loss of carbon dioxide) and oxygenation (and result losses of iron and trace metals) can affect analytical results for water quality constituents at the parts per million level. The extent to which the results for these water quality parameters are sensitive to sampling procedures is a function of the major ion chemistry and chemical speciation. Therefore, complete mineral analyses should be included in most sampling programs, if only on a limited basis.

The Addendum must include decision rules and contingency response actions if the monitoring results exceed the screening level criteria and/or indicate that groundwater is recontaminating the sediments within the EMJ RAB. While a contingency plan is identified in Section 6.2 of the OMMP (Appendix F of the Basis of Design Report), it does not include enough detail specific to the groundwater pathway. The Addendum must include a more detailed contingency plan where the groundwater screening level criteria are exceeded and/or where groundwater may be the source of recontamination of the sediments within the EMJ RAB. The Addendum must provide a basis explaining how the contingency plan aligns with the requirements of the Action Memorandum specific to assessing the groundwater to sediment pathway and assessing effectiveness of source control (described previously in this letter).

Stormwater Sampling and Monitoring

The NTCRA, as defined in the Action Memorandum, includes stormwater monitoring:

> *Storm water must be monitored to ensure any water release to the LDW will not result in recontamination of sediments or harmful exposure to benthic organisms.*

The Addendum must be revised to describe how the stormwater SAP is designed to meet the above objective identified in the Action Memorandum. These revisions must include greater detail of Jorgensen Forge Facility's stormwater management system, including: a conceptual site model specific to the stormwater as a pathway to the sediments within the EMJ RAB; the total acreage of stormwater that drains in to the stormwater system; the maximum capacity of the stormwater treatment system; details of how stormwater that exceeds the treatment system's capacity is handled/managed; any known history of cleaning of the stormwater system that has occurred (e.g. line cleaning); how the stormwater system is maintained; and any information regarding base flows from groundwater infiltrating the stormwater system in addition to stormwater.

The Addendum must be revised to include a detailed description of how the stormwater SAP is designed to fully characterize the stormwater effluent being discharged in to the EMJ RAB. The current Addendum is not designed to fully characterize the stormwater effluent, does not include characterization of the receiving water for comparison to the stormwater effluent, and does not correlate the stormwater SAP data to sediment concentrations of COCs within the EMJ RAB.

In order to fully characterize the stormwater effluent being discharges in to the EMJ RAB, EPA requires the following additional revisions be included in the Addendum:

- Monitoring for solids within the stormwater SAP. Because the stormwater sampling objective is specific to recontamination from the stormwater pathway to the sediments within the RAB, EMJ is required to include sampling for solids within the stormwater system, in addition to whole water. Sampling for whole water and sediments will provide a more complete characterization of the effluent being discharged into the RAB, and is consistent with other LDW Early Action Areas. For example, the North Boeing Field SAP for the long-term stormwater treatment system includes the collection of filtered solids and flow weighted composite sampling for its treated effluent to characterize potential contaminated sediments being discharged on to the LDW Superfund site.

- Flow data within the stormwater SAP. Flow data will verify volume estimates and track changes over time that do not appear to be the result of storm events. Flow data will also identify any potential base flow that may be occurring at the Site. Where an estimated volume used, the Addendum must specify the method to be used for deriving flow estimation.

- A technical basis within the stormwater SAP describing how the frequency of monitoring will provide representative data that characterizes the stormwater effluent being discharged to the EMJ RAB. In reviewing the current revised draft Addendum, there is no technical justification of how the current monitoring frequency ensures providing representative data to characterize the discharge from the stormwater outfall. EPA recommends EMJ utilize a tiered approach for monitoring, with more frequent monitoring over the first year (monthly) in addition to sampling a sufficient number of storm events. Using a tiered approach, EMJ could then propose scaling back the extent of monitoring depending on the results from the first year of monitoring data.

- A technical basis describing the number of samples and sample volumes that will be collected based on the number of constituents that will be analyzed. These calculations must also be revised to include samples of solids from the effluent. This information is currently missing in the main text of the document.

- A technical basis supporting the stormwater SAP sample collection timing and methodology to ensure it effectively characterizes the effluent discharge to the EMJ RAB. For example, the current Addendum states that stormwater samples will be collected within the first 12 hours of stormwater discharge, but provides no technical basis as to how this timeframe ensures that the data collected are representative of the effluent. Additionally, the citation date for Ecology's sampling guidance *How To Do Stormwater Sampling- A Guide to Industrial Facilities* is incorrect and must be revised.

The Addendum must be revised to include a technical justification for the screening level criteria within the stormwater SAP that relates to the objective of assessing recontamination of the sediments within the EMJ RAB. The current revised draft Addendum lacks any technical basis defining the relationship of the stormwater screening level criteria, found in Exhibit D of the Addendum, to sediment concentrations RvALs that apply to the EMJ RAB.

The EPA provided the same requirement in its October 7, 2014 comment letter. While the current Addendum includes a discussion of screening levels, it still lacks a technical basis relating the proposed screening levels to assessing the sediment concentrations of COCs within the EMJ RAB. The screening level criteria, found in Exhibit D of the current revised draft Addendum, only utilize the marine surface water quality criteria developed to protect aquatic life. Furthermore- the table does not even include the sediment RvALs, which are the basis for assessing recontamination of the sediments within the EMJ RAB. The revised stormwater screening level criteria in must include the sediment RvALs. The table of screening level criteria must be inserted in to the body of the Addendum within the stormwater SAP.

In its October 7, 2014 comment letter, the EPA also noted that EPA Method 8082 for detecting PCB is only appropriate if the laboratory used additional mechanisms to increase the sensitivity of the methodology:

> *EMJ must revise the analytical methodology used to achieve more sensitive detection limits for PCBs. Method 8082 is only appropriate if the selected lab utilizes the options within the methodology that allow for more sensitive detection limits. Utilizing options provided within Method 8082 to achieve a more sensitive detection limit is consistent with PCB monitoring of stormwater at surround Early Action Areas (EAAs) on the LDW. For example, at the Slip 4 EAA, the selected laboratory, ARI, utilizes a larger sample volume and a different solvent to attain more sensitive minimum detection limits. At T-117, the City of Seattle is, similarly, proposing to utilize the options identified in the Method 8082 documents to achieve a detection limit that is more sensitive. EMJ is required to do the same.*

It is still unclear within the current revised draft Addendum if EMJ made the necessary revisions to address this comment. The Addendum must be revised and confirm that EMJ intends to revise the analytical methodology used to achieve the more sensitive detection limit for PCBs.

The Addendum must be revised to include a technical basis describing how the stormwater SAP aligns with the long-term sediment monitoring plan defined in the OMMP; and how surface sediment data will be used to assess if recontamination is occurring due to the stormwater pathway. The BODR intended to collect sediment sampling data within the EMJ RAB for the purposes of monitoring stormwater effluent impacts. The OMMP within the BODR includes one surface sediment sample location that was intended to align with the discharge area of stormwater from the Jorgensen Forge Facility. However, that location was based on a proposed outfall that was to be constructed as part of the NTCRA, which did not occur:

> *A sixth sediment sample (LTR-4) is specifically located to monitoring potential sediment quality impacts from the discharge area of the new outfall that will be constructed during the removal action. Surface sediment samples collected within the RAB will be submitted for chemical analysis for the chemicals of concern (COCs). . . .*

Because the new outfall was never constructed by Jorgensen Forge, there is no relationship between sediment sampling LTR-4 and the stormwater discharge point. Therefore, the EPA requires EMJ revise the location of LTR-4 to align with the existing stormwater discharge location of Outfall 3.

The Addendum for the stormwater SAP must be revised to include decision rules and contingency response actions if the monitoring results exceed the screening level criteria and/or indicate that stormwater is recontaminating the sediments within the EMJ RAB. While a contingency plan is identified in Section 6.2 of the OMMP (Appendix F of the BODR), it does not include enough detail specific to the stormwater pathway. The Addendum must provide a technical basis explaining how the contingency plan aligns with the requirements of the Action Memorandum in assessing the stormwater to in-waterway sediment pathway and recontamination.

The stormwater SAP Addendum must include a revision to the naming convention for the stormwater sampling to reflect that the sample is not being pulled from Outfall 3, but instead from the stormwater collection vault.

EMJ should consider the stormwater sampling plans of other Early Action Areas within the Lower Duwamish Waterway for examples of how stormwater sampling data can be used to evaluate in-water sediment concentrations. For example, at T-117, it has been proposed that surface sediment samples be taken around the outfall at the site. In the event any of those surface sediment samples exceed the PCB criterion of 12 mg/kg OC, then existing surface sediment data from surrounding areas will be obtained/reviewed to see if the SCO criterion is exceeded elsewhere. Spatial and temporal trends, along with Aroclor component analysis, will also be reviewed to gain insights regarding the causes of any exceedances near the outfall. Finally, storm drain solids data will be evaluated to assess its possible contribution to exceedances of the PCB criterion near the outfall.

Scheduling

The Addendum must include notifying EPA at least four weeks prior to scheduled monitoring events for the purpose of scheduling such activities to accommodate EPA participation, if requested.

Report

The Addendum must specify that the groundwater and stormwater reports provided to EPA include the data, data validation report, and evaluation.

QAPP

The QAPP should identify Gina Grepo-Grove as the QA/QC Manager for EPA.

The QAPP identifies ARI as the lab performing the data analysis, while EcoChem will be performing the data analysis. The revised QAPP must define the stage when the data will be validated by EcoChem.

The QAPP does not identify what the Data Quality Objectives are for this project. The Addendum must be revised to include defined Data Quality Objectives, which should be included in the main body of the Addendum as well as the QAPP. As previously described, the objectives of these monitoring events must include references to the Action Memorandum requirements.

EPA noted in its prior comment letter:

> *EPA's Forum on Environmental Measurement (FEM) requires the laboratory and field workers to demonstrate competency. This must include the training and qualifications of the personnel that will handle this project. This must also include the current accreditation/certification and QA Manual of the laboratory. The Addendum must be revised to include this information for all laboratory and field workers who will be performing the sampling and analysis of the groundwater and stormwater data.*

The information provided in Section 5 of the QAPP does not include sufficient detail. The revised Addendum should include greater detail related to this requirement.

Under Sampling Process Design, include a table that identifies the number of samples that will be collected at each location, detection limits, preservation requirements, sample locations (lat/long), volume of medial collected for each analyte or procedure and a list of analyses matrix. The Addendum should include this in both the main text and the QAPP.

Section 17.1 of the QAPP states that the laboratory will provide written details of any planned modifications to laboratory protocols for Farallon's review. The QAPP must be revised to include EPA review and approval in any modifications to laboratory protocols, in addition to Farallon's review.

As required by the Settlement Agreement, a revised draft Addendum, which incorporates all of the comments and revisions provided by EPA in this letter, must be submitted to EPA within 30 days of the date of this letter. Should EMJ fail to do so, EPA will consider the various alternatives for accomplishing this Work, which include producing the Addendum itself and billing EMJ for the associated costs, as provided for under the Settlement Agreement. Please contact me with any questions.

Sincerely,

Rebecca Chu

Rebecca Chu
Remedial Project Manager

cc: Miles Dryer, Jorgensen Forge Corporation
Ryan Barth, Anchor QEA
Romy Freier-Coppinger, Washington State Department of Ecology
Glen St. Amant, Muckleshoot Tribe
Alison O' Sullivan, Suquamish Tribe
James Rasmussen, DRCC/TAG
Jessica Winter, NOAA
Brian Anderson, The Boeing Company

ATTACHMENT B
ADDENDUM NO. 1 TO THE OMMP, DATED MAY 22, 2015

RESPONSE TO EPA COMMENTS ON THE NOVEMBER 20, 2014 REVISED DRAFT ADDENDUM TO THE OPERATIONS, MONITORING, AND MAINTENANCE PLAN, BASIS OF DESIGN REPORT
Jorgensen Forge Early Action Area Removal Action
Seattle, Washington

Farallon PN: 831-032

Washington
Issaquah | Bellingham | Seattle
Oregon
Portland | Bend
California
Oakland | Sacramento | Irvine

ADDENDUM NO. 1 TO THE OPERATIONS, MONITORING, AND MAINTENANCE PLAN, BASIS OF DESIGN REPORT

JORGENSEN FORGE EARLY ACTION AREA REMOVAL ACTION
U.S. ENVIRONMENTAL PROTECTION AGENCY DOCKET NO. CERCLA-10-2013-0032
SEATTLE, WASHINGTON

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May 22, 2015

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1.0 INTRODUCTION

On behalf of Earle M. Jorgensen Company (EMJ), Farallon Consulting, L.L.C. (Farallon) has prepared this Addendum No. 1 to the Operations, Monitoring, and Maintenance Plan (OMMP) of the Basis of Design Report, Jorgensen Forge Early Action Area prepared by Anchor, QEA LLC (2013b) (BODR), and approved by the U.S. Environmental Protection Agency (EPA) in a letter to Anchor QEA, LLC on August 16, 2013. The BODR provided the design basis for the Non-Time-Critical Removal Action (NTRCA) of contaminated sediments within the area defined as the Removal Action Boundary (RAB) and associated bank soil in a portion of the Lower Duwamish Waterway (LDW) Superfund Site adjacent to the Jorgensen Forge Facility in Seattle, King County, Washington (Facility) (herein referred to as the EMJ NTCRA). The EMJ NTCRA included in-water dredging, shoreline excavation, placement of backfill and armor materials, transport and off-site disposal of impacted sediments and soil, and associated construction activities were completed in 2014. Long-term monitoring and maintenance are a required part of the EMJ NTCRA.

The OMMP provides the scope of work for the long-term monitoring and maintenance requirements for the EMJ NTCRA to confirm that performance standards are met, and to demonstrate that upland source controls at the Jorgensen Forge Facility at 8531 East Marginal Way South in Seattle, Washington (herein referred to as the Jorgensen Forge Facility) minimize the potential for sediment recontamination. This Addendum No. 1 includes the scope of work for the groundwater and stormwater monitoring component of the OMMP.

The EMJ NTCRA is a requirement of the Administrative Settlement Agreement and Order of Consent for Removal Action Implementation issued by EPA (2012) Region 10 on November 5, 2012 under EPA Docket No. Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Docket No.-10-2013-0032, and attached Statement of Work, and the Action Memorandum, Responsiveness Summary, Jorgensen Forge Early Action Area, 8531 East Marginal Way South, Seattle, Washington, CERCLA Administrative Order on Consent prepared by EPA (2011) on October 7, 2011 for a Non-Time Critical Removal Action (Action Memo).

The purpose of the EMJ NTCRA is to reduce the concentrations of arsenic, cadmium, chromium, copper, lead, mercury, silver, zinc, and total polychlorinated biphenyls (PCBs) (defined as the constituents of concern [COCs]) in sediments to levels that are protective of human health and the environment (EPA 2011). As discussed in Section 6.2 of the OMMP, the potential exists for migration of COCs from upland sources (that include soil, groundwater, stormwater, and solids) to recontaminate sediments in the RAB. Monitoring is required to confirm that groundwater migrating from the Jorgensen Forge Facility to sediments in the RAB, and stormwater and solids discharging from the Jorgensen Forge Facility, do not contain concentrations of COCs that could result in recontamination of sediments in the RAB.

This Addendum No. 1 provides the scope of work for collection and analysis of soil, groundwater, stormwater, and catch basin solid samples at the Jorgensen Forge Facility in 2015, 2016, 2017, and 2018. This Addendum No. 1 also includes a description of sampling and analysis procedures and reporting.

2.0 SCOPE OF WORK

The objectives of the groundwater, stormwater, and solids monitoring is to confirm that performance standards are being met in the years following the EMJ NTCRA, and to demonstrate that the Jorgensen Forge Facility source controls are effectively protecting the quality of the adjacent river sediments and preventing their recontamination.

The objectives of the EMJ NTCRA defined in the Action Memo are to:

- Reduce the risk to human health and the environment by demonstrating that COCs are not migrating to LDW sediments through the groundwater pathway; and
- Reduce risks to human health and crabs, fish, birds, and mammals from exposure to COCs by monitoring stormwater and solids to ensure that COC concentrations are less than protective levels.

The proposed scope of work includes the following work to meet the EPA (2011) objectives:

- Installation of two monitoring wells on the shoreline of the Jorgensen Forge Facility;
- Collection and analysis of groundwater samples from the existing and newly installed monitoring wells at the Jorgensen Forge Facility;
- Collection and analysis of stormwater samples from Outfall 003 on the Jorgensen Forge Facility; and
- Collection and analysis of solids (if possible) from the stormwater conveyance system on the Jorgensen Forge Facility.

The proposed project schedule for monitoring well installation, soil sampling, groundwater sampling, stormwater, and solids sampling is summarized in Table 1.

3.0 BASELINE DATA AND GROUNDWATER CONCEPTUAL SITE MODEL

This section presents baseline groundwater, soil, stormwater, and solids data and the groundwater conceptual site model.

3.1 GROUNDWATER BASELINE DATA AND GROUNDWATER CONCEPTUAL SITE MODEL

The analytical results for groundwater samples collected from monitoring wells on the Jorgensen Forge Facility between 2003 and 2011 provide a robust groundwater data set, include analysis of groundwater for the COCs for sediments defined in the RAB, and define baseline groundwater conditions (Table 2). The Action Memo states, "the migration pathway for discharge of groundwater is complete but concentrations of COCs have not been detected in groundwater exceeding the [then applicable] screening levels, with the exceptions of single anomalous detections of COCs in groundwater collected from single monitoring wells located in discrete areas of the RAB." The baseline groundwater conditions confirm that COCs in groundwater did not exceed the screening levels applicable at the time, with the exception of occasions when the analytical results were either false, attributed to off-site sources, or representative of natural background concentrations.

The groundwater flow direction has been observed to be southwest on the eastern portion, and west on the western portion of the Jorgensen Forge Facility, adjacent to the LDW. Groundwater discharges to the LDW from the Jorgensen Forge Facility.

Concentrations of PCBs have not been detected in groundwater on the Jorgensen Forge Facility, with two exceptions:

- An isolated detection of total PCBs in the groundwater sample collected from monitoring well MW-6 in June 2003 likely is a false detection (Anchor QEA LLC and Farallon 2008).
- PCBs detected in reconnaissance groundwater at sampling locations T2B4 and T3B4 at the northwestern corner of the Jorgensen Forge Facility. These results are likely biased high and due to presence of suspended solids typically observed in reconnaissance groundwater samples.

Concentrations of PCBs have not been detected in the cutting oil plume of LNAPL in Area 1.

The concentrations of dissolved mercury and silver detected in groundwater have been less than the selected screening levels (Table 5). Metals detected in groundwater at concentrations exceeding the selected screening levels include arsenic, cadmium, chromium, copper, lead, and zinc. Concentrations of dissolved arsenic, cadmium, chromium, copper, lead, and zinc detected in groundwater at the Jorgensen Forge Facility either are attributable to naturally occurring metals in groundwater, or were detected in reconnaissance groundwater samples that are not representative of groundwater conditions and likely are not associated with releases on the Jorgensen Forge Facility (Anchor and Farallon 2008).

Direct discharge of groundwater to sediments or surface water in the LDW through seeps is a primary pathway from the Site to the LDW. Soil is currently not a direct pathway to the LDW. Leaching of COCs in soil to groundwater is a suspected pathway from the Site to the LDW. The existing groundwater data for the Jorgensen Forge Facility indicates that chemicals in soil have not leached to groundwater at concentrations that may potentially result in adverse impacts to LDW sediment quality. Based on observed groundwater conditions, the potential for future leaching of chemicals in soil to groundwater is low.

3.2 STORMWATER AND SOLIDS BASELINE DATA

The stormwater conveyance system on the Jorgensen Forge Facility was installed in early 2013 to include pre-treatment of stormwater, and discharge via one outfall. Upgrades to the system were completed in August 2014. Therefore, stormwater data collected monthly at the Jorgensen Forge Facility from September 2014 to the present under the National Pollution Discharge Elimination System (NPDES) permit are representative of post-NTCRA stormwater discharge conditions, and define the stormwater baseline data for this Addendum No. 1 (Table 2). The NPDES stormwater data from 2013 to the present include the analysis of stormwater for the COCs for sediments defined in the RAB.

Concentrations of cadmium, chromium, copper, lead, mercury, silver, and zinc exceeding the screening levels were detected in solids collected from catch basins prior to installation of the stormwater treatment system in March 2013 to treat stormwater runoff. Total PCBs were not detected above the screening level selected on Table 5.

3.3 SOIL BASELINE DATA

The analytical results for soil samples collected along the shoreline at the Jorgensen Forge Facility between 1990 and 2013 provide a soil sampling data set that includes analysis for the COCs for sediments defined in the RAB and defines baseline soil conditions (Tables 3 and 4).

Concentrations of arsenic, cadmium, chromium, copper, lead, zinc, and total PCBs exceeding the selected screening levels (Table 5) were detected in soil samples collected from the along the shoreline of the Jorgensen Forge Facility prior to the removal action conducted in the summer of 2014. During the removal action the soils along the shoreline bank were removed, and the shoreline was backfilled with clean soil and armored. Concentrations of arsenic, cadmium, chromium, copper, lead, zinc, and total PCBs exceeding the selected screening levels were also detected in soil sampled collected from the northwest corner of the property near the Boeing Plant 2 property at the Jorgensen Forge Outfall site.

4.0 SCREENING LEVELS

In the Action Memo, EPA requires that screening levels for soil, groundwater, stormwater, and solids be defined based on pathways and protection of organisms and humans that could come in contact with sediments of the LDW. Farallon has evaluated various screening levels for each of the media that will be sampled under the OMMP that could act as a source of COCs to sediments in the LDW. Direct discharge of groundwater to sediments or surface water in the LDW through seeps is a primary pathway from the Site to the LDW. Leaching of COCs in soil to groundwater is a suspected pathway from the Site to the LDW.

The screening levels evaluated are summarized in Table 5. The screening levels considered applicable to the EMJ NTCRA are as follows:

- Soil: The Boeing Plant 2 (2011) EPA Proposed Target Media Cleanup Levels (TMCLs) for the LDW (Boeing Plant 2 TMCLs).
- Groundwater: The Washington State Human Health Criteria for Consumption of Organisms, Boeing Plant 2 TMCLs, and Aquatic Life Criteria.
- Stormwater: The Washington State Model Toxics Control Act Cleanup Regulation (MTCA) Method B Standard Formula Values for Surface Water, Boeing Plant 2 TMCLs, and Aquatic Life Criteria.
- Solids: The Removal Action Levels (RvALs) for sediments outlined in the Action Memo.

COCs detected in soil, groundwater, stormwater, and solids samples collected on the Jorgensen Forge Facility under this Addendum No. 1 will be compared to the screening level values shown in Table 5 and defined below. Based on discussions with EPA and requirements of the Action Memo, EMJ selected the Boeing Plant 2 TMCLs as the screening levels for soil, groundwater, stormwater, and solids

An exceedance of a screening level value does not necessarily indicate any or unacceptable risk. An exceedance of a screening level value indicates that other lines of evidence are to be evaluated to determine whether there is a source to a potential upland contaminant migration pathway, and whether additional source control is necessary, such as resampling (if possible) and coordination with Jorgensen Forge for evaluation of on-site source control measures, possible sources, and best management practices.

4.1 SOIL

The selected screening levels for COCs in soil are the Boeing Plant 2 TMCLs (Table 5). The Boeing Plant 2 TMCLs for soil were developed by Boeing (2011) using the evaluation of U.S. EPA regional screening levels for chemical contaminants at superfund sites for residential and industrial exposures, MTCA Method C for industrial exposure, and MTCA Method B for residential exposures.

Soil is not a direct pathway to sediments in the LDW at the Jorgensen Forge Facility, as the bank is armored and there is no direct erosion to the LDW. Soil in contact with groundwater could be a source of COCs to groundwater that is a direct pathway to sediments in the LDW.

The three-phase partitioning method in Section 747 of Chapter 173-340 of the Washington Administrative Code (WAC 173-340-747) was used by Boeing (2011) to estimate the concentrations of a COC in soil that could result in a concentration in groundwater that would exceed a selected cleanup screening level. The bases for the exposure pathways for the TMCLs used by Boeing (2011) include Washington State Background concentrations for arsenic; concentrations of cadmium, copper, mercury, silver, and zinc in soil protective of aquatic species exposed to groundwater; EPA regional screening levels for residential exposure scenarious, including ingestion, dermal, and inhalation for chromium (VI); and the MTCA Method A Residential screening level for lead. The TMCL for total PCBs in soil used by Boeing (2011) is the concentration of PCBs in soil that would result in concentrations in groundwater that are protective of tribal seafood. Because the TMCL for total PCBs is lower than the laboratory limit of quantitation (LOQ), the LOQ is used as the screening level for total PCBs in soil.

The screening level values for COCs in soil are as follows, presented in milligrams per kilogram (mg/kg):

- Arsenic = 20
- Cadmium = 4.0
- Chromium = 1.2
- Copper = 80
- Lead = 250
- Mercury = 1.5
- Silver = 170
- Zinc = 1,400
- Total PCBs = 0.18

4.2 GROUNDWATER

The selected screening levels for COCs in groundwater are the Boeing Plant 2 TMCLs (Table 5). Boeing (2011) relied on the EPA (2007) *Draft Framework for Selecting and Using Tribal Fish and Shellfish Consumption Rates for Risk-Based Decision Making at CERCLA and RCRA Cleanup Sites in Puget Sound and the Strait of Georgia* dated August 2007, to calculate the TMCLs in accordance with WAC 173-340-720(1)(i). These screening levels are more conservative and are more human health-protective cleanup levels than other calculated groundwater screening levels.

Groundwater is a complete pathway to the LDW. The bases for the exposure pathways for the TMCLs include the LDW groundwater background levels for arsenic and copper, Freshwater Chronic Water Quality criteria to protect aquatic species screening levels for cadmium, lead, and mercury, and EPA Region 10 tribal consumption of seafood screening levels for chromium (VI), silver, and zinc. The TMCL used for total PCBs is the EPA Region 10 tribal consumption of seafood screening level. Because the TMCL for total PCBs is lower than the LOQ, the LOQ is used as the screening level for total PCBs in groundwater.

The screening level values for COCs in groundwater are as follows, presented in micrograms per liter (µg/l):

- Arsenic = 8.0
- Cadmium = 0.25
- Chromium = 0.58
- Copper = 8.0
- Lead = 2.5
- Mercury = 0.012
- Silver = 22
- Zinc = 56
- Total PCBs = 0.09

4.3 STORMWATER

The selected screening levels for COCs in stormwater are the Boeing Plant 2 TMCLs (Table 5). The TMCLs used by Boeing (2011) were based on protection of human health, aquatic species, and drinking water when surface water protection was not possible, with modification for considerations of Tribal and Asian and Pacific Islanders' seafood consumption rates.

Stormwater is discharged directly to the LDW through Outfall 003. The bases for the exposure pathways for the TMCLs used by Boeing (2011) include the LDW groundwater background levels for arsenic and copper; Freshwater Chronic Water Quality criteria to protect aquatic species screening levels for cadmium, lead, and mercury; and EPA Region 10 tribal consumption of seafood screening levels for chromium (VI), silver, and zinc. The TMCL used by Boeing (2011) for total PCBs is the EPA R10 tribal consumption of seafood screening level. Because the TMCL for total PCBs is lower than the laboratory LOQ, the LOQ is used as the screening level for total PCBs in stormwater.

The screening levels values for COCs in stormwater are as follows, presented in µg/l :

- Arsenic = 8.0
- Cadmium = 0.25

- Chromium = 0.58
- Copper = 8.0
- Lead = 2.5
- Mercury = 0.012
- Silver = 22
- Zinc = 56
- Total PCBs = 0.09

4.4 SOLIDS

The selected screening levels for COCs in solids are the RvALs for sediments defined in the Action Memo (Table 5). Solids are a direct release to the LDW through stormwater discharge via Outfall 003. Comparing solids results to the RvALs for sediments is representative of the mass loading from solids to sediments, and protective of LDW sediments.

The screening levels values for COCs in solids are as follows, presented in mg/kg:

- Arsenic = 57
- Cadmium = 5.1
- Chromium = 260
- Copper = 390
- Lead = 450
- Mercury = 0.41
- Silver = 6.1
- Zinc = 410
- Total PCBs = 12 (mg/kg-organic carbon)

5.0 GROUNDWATER MONITORING WELL INSTALLATION

Monitoring wells MW-53 and MW-54 will be installed along the shoreline of the Jorgensen Forge Facility (Figure 1). The monitoring wells will be screened at depths of between 23 and 27 feet below ground surface (bgs) to monitor groundwater at the approximate elevation of sediments dredged in the RAB during the NTCRA. The groundwater monitoring wells will be installed in accordance with Farallon's standard operating procedures (Appendix B), which are based on the *Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells* dated March 1991 prepared by EPA (1991), and the Minimum Standards for Construction and Maintenance of Wells (WAC 173-160), last updated November 2006.

Farallon will retain public and private utility locating services to clear the proposed monitoring well locations and provide additional information pertaining to the locations of subsurface utilities on and near the monitoring well locations (Figure 1). The monitoring well locations may be modified, as necessary, during field activities based on access considerations, and the location of utilities and equipment. Health and safety requirements for monitoring well installation are provided in the Health and Safety Plan (HASP) (Appendix A).

The subsurface conditions at MW-53 and MW-54 are likely to be similar to those encountered in monitoring well MW-52, located near the proposed monitoring well locations, which consist of well-graded sand (fill) from approximately 0 to 20 feet bgs, and poorly graded sand from 20 to 27 feet bgs. The well screens will be placed below the fill/native contact. If the drilling results in refusal due to obstructions, or other unexpected soil conditions are encountered, the boring location will be moved approximately 5 to 10 feet away from the original location and redrilled. The process will be continued until the boring is advanced to the required 27 feet bgs depth.

The monitoring well borings will be advanced using a mobile auger drill rig. A Farallon Geologist will observe subsurface conditions and record information on the boring logs, including the soil types encountered, visual and olfactory evidence of contamination, and volatile organic vapor concentrations as measured using a photoionization detector. Farallon will record the results of these soil contamination detection methods when advancing soil borings and collecting soil samples in accordance with Farallon's standard operating procedures (Appendix B). Before the auger borings are advanced at each groundwater monitoring well location, Farallon will perform a standard penetration test and record the results in the field notes and on the boring logs.

The monitoring wells will be constructed of 2-inch-diameter Schedule 40 polyvinyl chloride casing and 0.010-inch slotted screens to a maximum depth of approximately 30 feet bgs. Type 2/12 filter pack will be used in each monitoring well based on the anticipated geology at the Site of well-graded sand. The monitoring wells will be completed with flush-mounted steel monuments, and developed immediately following installation. Following well installation, the locations and elevations of the two new monitoring wells will be surveyed by a Washington State-licensed surveyor. A Log of Boring form and a Monitoring Well Construction Data form will be completed for the two new groundwater monitoring wells installed at the Site (Appendix C).

The monitoring wells will be developed to create an effective filter pack around the well screen, rectify damage to the formation caused by drilling, remove fine particulates from the formation near the borehole, and assist in restoring the natural water quality of the aquifer in the vicinity of the well. A surge block will be used to create a surging action in each well, and a submersible pump will be used to purge a minimum of three and a maximum of five well volumes, including the volume of drilling process water, if used. If the well becomes dry before the minimum volume is purged, the well will be allowed to recharge before purging continues. The turbidity of the purge water during well development will be observed and recorded. The well will be developed until purge water turbidity is less than or equal to 25 nephelometric turbidity units, in accordance with Farallon's standard operating procedures regarding well development (Appendix B).

5.1 SOIL SAMPLING PROCEDURES

Farallon will collect and retain soil samples from the two borings for the monitoring well installation. Soil samples will be collected every 5 feet during advancement of the borings, including in the vadose zone, and the saturated zone at the location of the well screen. Soil samples will be retained for analysis pending receipt of analytical results for the groundwater samples collected from the monitoring wells to be installed in the borings. Health and safety requirements for the soil sampling are provided in the HASP (Appendix A).

The soil samples will be assigned a unique sample identifier and number. The number will include a prefix of the boring identification, sample depth, and date. For example, a soil sample collected from boring MW-53 at 5.0 feet bgs on August 15, 2015 would be numbered MW53-5.0-081515. The sample identification will be placed on the sample label, the boring log, and a Chain of Custody form.

If COCs are detected above the selected groundwater screening level in a groundwater sample collected from the monitoring well installed in the boring, the soil samples collected from the saturated zone and the vadose zone of that boring will be analyzed for the COCs detected in the groundwater sample. The soil samples will be submitted to Analytical Resources, Inc. of Tukwila, Washington (ARI) and placed on hold pending receipt of results for the groundwater monitoring well samples. Farallon's standard operating procedures for soil sampling from borings is provided in Appendix B. The soil sample latitude and longitude, number of samples to be collected, matrix, parameters, sample size, container size and type, holding times, preservation type, and limits of quantitation are provided in Table 4 of the QAPP (Appendix D) and below.

Appendix D--QAPP Table 4
Groundwater, Stormwater, Solids, and Soil Sampling Information

Location	Sample Location (Lat/Long)	No. of samples to be collected over 3 years	Matrix	Parameters to be analyzed for each sample	Sample Size	Container Size and Type	Holding Time	Sample Preservation Technique	LOQ
SW System Effluent Port	N: 195426.94 E: 1276288.86 (approximate)	2 to 12 (2 total, up to 4 annually)	Solids	Metals	1 oz.	25 liter plastic container filtered with 5 micron filter by laboratory	6 months	Cool/4°C	5.0 mg/kg wet weight (except Mercury is 0.025 mg/kg-wet weight)
				PCBs	2 oz.	25 liter plastic container filtered with 5 micron filter by laboratory	14 days	Cool/4°C	0.02 mg/kg wet weight
				TOC	1 oz.	25 liter plastic container filtered with 5 micron filter by laboratory	14 days	Cool/4°C	200 mg/kg
		6 to 12 (2 to 4 annually)	Stormwater	Metals, dissolved	500 ml	500 ml HDPE	6 months	HNO_3 to pH < 2	0.01 µg/l (except Mercury is 0.0004)
				Metals, total	500 ml	500 ml HDPE	28 days	HNO_3 to pH < 3	
				PCBs	1,000 ml	1 x 1,000 ml amber glass	7 days until extraction	Cool/4°C	0.01 µg/l
							40 days after extraction (hexane solvent used for extraction)	Cool/4°C	
MW-52	N: 195659.56 E: 1275893.45	3 (1 annually)	Groundwater	Metals, dissolved	500 ml	500 ml HDPE	6 months	HNO_3 to pH < 2	0.01 µg/l (except Mercury is 0.0004)
				Metals, total	500 ml	500 ml HDPE	28 days	HNO_3 to pH < 3	
MW-53	N: 195524.78 E: 1275958.29 (tentative)			PCBs	1,000 ml	1 x 1,000 ml amber glass	7 days until extraction	Cool/4°C	0.01 µg/l
MW-54	N: 195384.06 E: 1276013.20 (tentative)						40 days after extraction (hexane solvent used for extraction)	Cool/4°C	
		Approx. 6 (one-time event)	Soil	Metals	4 oz.	4 oz. glass jar	6 months	Cool/4°C	5.0 mg/kg wet weight (except Mercury is 0.025 mg/kg-wet weight)
				PCBs	8 oz.	8 oz. glass jar	14 days	Cool/4°C	0.02 mg/kg wet weight

NOTES:
°C = degrees Celsius
µg/l = micrograms per liter
E =easting in North American Datum 1983
EAA = Early Action Area
HDPE = high-density polyethylene
HNO_3 = nitric acid
LOQ = limit of detection
ml = milliliter
mg/kg = milligrams/kilogram
N = northing in North American Datum 1983
oz = ounce
PCBs = polychlorinated biphenyls
TOC = total organic carbon

6.0 GROUNDWATER MONITORING AND SAMPLING

Groundwater monitoring is required to provide sufficient data to confirm that the removal action objective to "reduce migration of contaminants in groundwater to sediments to reduce the risk to human health and the environment" is met (EPA 2011). The groundwater monitoring and sampling will provide sufficient information to confirm that the removal action objective is met by monitoring COCs in groundwater at the elevation of sediments in the RAB to demonstrate that groundwater is not a source and pathway of COCs to sediments.Groundwater samples will be collected annually during the third quarter in the same month of the year for 3 years, in 2015, 2016, and 2017. Farallon will notify EPA at least 4 weeks prior to scheduling groundwater monitoring events to accommodate EPA participation, if requested. The first groundwater monitoring event in 2015 will be conducted 3 days after the monitoring wells have been installed. Groundwater elevations will be measured, and groundwater samples will be collected from existing monitoring well MW-52 and newly installed monitoring wells MW-53 and MW-54. Groundwater samples will be collected during a falling tide to ensure the samples are representative of upland groundwater conditions. The wells will be sampled annually during the third quarter of each year to correlate temporal trends for the 3 years of groundwater monitoring.

The groundwater samples will be analyzed for the COCs to assess whether the groundwater pathway is a source of COCs to sediments. Mass balance calculations will be used, if warranted, to determine the total mass loading of groundwater contaminants into sediments, taking into account natural background levels and a margin of safety. A margin of safety accounts for the uncertainty in the response of the waterbody to loading reductions and decided once groundwater and sediment results are evaluated.

The analytical results for sediments samples collected from sample locations LTR-1, LTR-2, and LTR-5 will be compared with the analytical results for groundwater samples collected from monitoring wells MW-52, MW-53, and MW-54, respectively, to determine whether groundwater is a potential source of COCs to sediments at these locations (Figure 1). Groundwater will be considered a potential source if the concentrations of COCs in groundwater samples collected from the monitoring wells exceed the screening levels; a source of COCs to groundwater is identified; and the concentrations of COCs exceed the RvALs in sediments samples collected at sample locations LTR-1, LTR-2, and/or LTR-5. A weight of evidence evaluation will be conducted to determine other potential sources.

6.1 GROUNDWATER SAMPLING PROCEDURES

Groundwater samples will be collected in accordance with Farallon's standard operating procedures regarding groundwater sampling (Appendix B) consistent with the EPA (1996a) guidance document *Low-Flow (Minimal Drawdown) Groundwater Sampling Procedures*, and the EPA (1996b) guidance document *Method 1669, Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels.* Health and safety requirements that will be followed during groundwater monitoring and sampling are discussed in the Health and Safety Plan (HASP) (Appendix A).

Tide charts will be reviewed prior to groundwater sampling to schedule sample collection during a falling tide. The monitoring wells will be purged at a low-flow rate (i.e., 100 milliliters per minute) using a peristaltic or bladder pump and dedicated polyethylene tubing. The pump intake will be placed at the approximate center of the screened interval. Temperature, pH, conductivity, and dissolved oxygen will be monitored during purging using a Horiba U-52 water-quality meter or equivalent meter equipped with a flow-through cell to determine when stabilization of these parameters occurs. Groundwater samples will be collected directly from the pump outlet following stabilization of temperature, pH, conductivity, and dissolved oxygen. If the monitoring well is completely dewatered during purging, samples will be collected when groundwater in the well has recovered at least 80 percent of the pre-purge casing volume.

The sample containers will be filled directly from the pump. The samples collected for dissolved metals will be filtered in the field using a 0.45-micron filter. Care will be taken not to handle the seal or lid of the container when the sample is decanted into the container. The containers will be filled completely to eliminate headspace, and the seal/lid will be secured. Each sample container will be labeled with the date and time sampled, well identification and number, project number, and preservative(s), if any. Sample collection information will be documented on a Chain of Custody form. The samples will be placed into a cooler at approximately 4 degrees Celsius and transported to the laboratory under standard chain-of-custody protocols.

A Low Flow Well Purging and Sampling Data form will be completed by a Field Scientist for each well sampled (Appendix C). Farallon will record the depth to groundwater, well purging information, and other pertinent hydrologic measurements and supplementary information collected during groundwater sampling at each monitoring well.

Purge water will be stored temporarily in a labeled container on the Site pending receipt of waste profiling results. An estimated volume of 20 to 30 gallons of purge and decontamination water is anticipated to be generated during each sampling event. All hazardous waste generated during monitoring activities will be stored on-site for no more than 90 days and disposed of by EMJ in accordance with EPA's rules and regulations for disposal of hazardous waste. Non-reusable sampling and health and safety supplies and equipment will be disposed of in proper waste receptacles.

The well cap and monument will be secured following sampling. Damage to or defect in a well cap or monument will be noted, and the well cap or monument will be scheduled for replacement if necessary.

6.2 GROUNDWATER SAMPLE DESIGNATION AND LABELING

The groundwater samples collected for compliance monitoring will be assigned a unique sample identifier and number. The number will include a prefix of the well identification and the date. For example, a groundwater sample collected from monitoring well MW-52 on August 15, 2015 would be numbered MW52-081515. The sample identification will be placed on the sample label, the Well Purging and Sampling Data form, and a Chain of Custody form.

6.3 LABORATORY ANALYSIS

Groundwater samples will be submitted to ARI for laboratory analysis for metals, including total and dissolved arsenic, cadmium, chromium, copper, lead, silver, and zinc by EPA Methods 6010B/6020, mercury by EPA Method 1631 E, and PCBs by EPA Method 8082. Detailed quantitation goals for precision, recovery, and completeness are presented in Table 1 of the QAPP (Appendix D).

Laboratory quality control criteria, including calibration, replicates, matrix spikes, control samples, duplicates, method blanks, and surrogate spike requirements are outlined in Table 2 of the QAPP. Table 4 of the QAPP presents the sample latitude/longitude locations, number of samples to be collected, matrix, parameters, sample size, container size and type, holding times, preservation type, and limits of quantitation for the groundwater samples.

7.0 STORMWATER MONITORING AND SAMPLING

The stormwater monitoring is designed to meet the objectives defined in the Action Memo by monitoring stormwater effluent to confirm that stormwater is not recontaminating sediments of the LDW or causing harmful exposure to benthic organisms. Stormwater samples will be analyzed for the COCs.

Concentrations of PCBs exceeding the screening levels have not been detected in stormwater samples collected from the Jorgensen Forge Facility (Table 2). Concentrations of dissolved chromium, copper, lead, and zinc have been detected exceeding the screening levels in stormwater samples collected from stormwater Outfall 003 from 2013 to the present (Table 2).

The Jorgensen Forge Facility currently manages stormwater runoff through a stormwater treatment system that includes a series of catch basins, interconnecting pipes, settling tanks, sand filters, pumps, flow and level monitoring equipment, and a control panel. Stormwater flows through the settling tanks and sand filters, and discharges to the LDW through Outfall 003 (SoundEarth Strategies [SES] 2014). Stormwater from a total of 12.5 acres of impermeable surface discharges to the treatment system on the Jorgensen Forge Facility. Stormwater from approximately 7.26 acres of permeable surface on the Jorgensen Forge Facility is allowed to infiltrate.

The treatment system includes a stormwater collection vault with pump station, five 10,500-gallon polyethylene tanks, and five pressurized sand filters. The treatment system has a hydraulic capacity of 550 gallons per minute. An additional 10,500-gallon tank and recirculation capabilities were added to the treatment train, and in October 2014, a total of ten 10-micron bag filters were installed followed by two 2,000-gallon media vessels containing a layered combination of purolite, zeolite, and granular activated carbon to remove sediments from stormwater. The media vessels are operated in lead and lag operation, and have a hydraulic capacity of 100 gallons per minute. Flows greater than 100 gallons per minute are recirculated through settling tanks (SES 2014). Since the addition of the bag filters and media vessels in October 2014, monthly sampling results indicate TSS is less than 10 mg/l.

Jorgensen Forge Corporation is responsible for the maintenance of the stormwater treatment system. The system and associated catch basins are routinely inspected, inserts replaced as needed or quarterly at a minimum, and cleaned annually, or when buildup of solids in the catch basins reaches 60 percent. The treatment system undergoes routine calibration and inspection by trained system operators per an on-site Operation and Maintenance manual (SES 2014).

Operational, source control, and treatment BMPs are implemented at the Jorgensen Forge Facility as follows to reduce the potential sources of metals to the stormwater drainage system:

- Operational BMPs include housekeeping, preventive maintenance of equipment, spill prevention and emergency cleanup, employee training, illicit discharges detection and elimination procedures, inspections, and record keeping.

- Source Control BMPs include grading and berming, use of catch basin filters, implementation of dust-control measures, use of spill kits in locations where materials are stored and loaded and/or unloaded, routine sweeping and vacuuming, and fuel spill prevention.
- Treatment BMPs include the installation and maintenance of the on-site stormwater treatment system, and pavement repair and maintenance as needed to prevent runoff infiltration.

The BMPs are detailed in the Stormwater Pollution Prevention Plan dated April 2014 prepared by SoundEarth Strategies (2014).

Data collected from the quarterly and semiannual stormwater sampling outlined within, and the NPDES permit data collected monthly by the Jorgensen Forge Corporation are sufficient to characterize the stormwater discharging from the Jorgensen Forge Facility. The stormwater sampling will be conducted to characterize the concentrations of COCs in stormwater effluent that discharges to the LDW via Outfall 003. Stormwater samples will be collected and analyzed using a tiered approach. During a minimum predicted rainfall of more than 0.2 inch during a storm event, stormwater will be collected quarterly for the first year of monitoring (i.e., during each of the following four quarters):

- First Quarter: January, February, or March;
- Second Quarter: April, May, or June;
- Third Quarter: July, August, or September; and
- Fourth Quarter: October, November, or December.

If COCs are not detected at concentrations exceeding the selected screening levels in the stormwater samples collected during the first four quarters, stormwater sampling frequency will be reduced to twice per year for two years, conducted during the following two quarters:

- Second Quarter: April, May, or June; and
- Fourth Quarter: October, November, or December.

If COCs are detected at concentrations exceeding the selected screening levels in the stormwater samples collected during the first four quarters, quarterly stormwater sampling will continue for another year through the third year, if needed. Table 5 below provides a summary of the screening level criteria.

Table 5
Screening Level Values and Laboratory Limits of Quantitation - Groundwater, Stormwater, Catch Basin Solids, and Soil

		Screening Levels														Laboratory LOQ Groundwater and Stormwater	Sediment, Soil, and Stormwater Solids
		Human Health Criteria for Consumption of Organisms[1]	Ecology MTCA Method B Standard Formula Values for Surface Water [2]		Boeing Plant 2 (EPA Proposed TMCL for LDW)[3]	Boeing Plant 2 (EPA Proposed TMCL for LDW)[3]	Aquatic Life Criteria[4]								RvALs[7]		
							Washington State WQC[5]				National AWQC[6]						
							Freshwater		Marine		Freshwater		Marine				
Parameter	Analytical Method	Groundwater (µg/l)	Non-Carcinogenic (µg/l)	Carcinogenic (µg/l)	Groundwater and Surface Water (µg/l)	Soil (mg/kg)	Chronic (µg/l)	Acute (µg/l)	Chronic (µg/l)	Acute (µg/l)	CCC (µg/l)	CMC (µg/l)	CCC (µg/l)	CMC (µg/l)	Sediments (mg/kg dry weight)	Total and Dissolved (µg/l)	Laboratory LOQ (mg/kg wet weight)
Metals																	
Arsenic	EPA 6020A ICP-MS	0.14	17.7	0.0982	8.0	20	190	360	36	69	150	340	36	69	57	0.2	0.2
Cadmium	EPA 6020A ICP-MS	NE	40.5	NE	0.25	4.0	1	3.7	9.3	42	0.25	2	8.8	40	5.1	0.1	0.1
Chromium	EPA 6020A ICP-MS	NE	243,000[8]	NE	0.58	1.2	10[9]	15[9]	50[9]	1,100[9]	11[9]	16[9]	50[9]	1,100[9]	260[8]	0.5	0.5
Copper	EPA 6020A ICP-MS	NE	2,880	NE	8.0	80	11.4	17	3.1	4.8	9	13	3.1	4.8	390	0.5	0.5
Lead	EPA 6020A ICP-MS	NE	NE	NE	2.5	250	2.5	65	8.1	210	2.5	65	8.1	210	450	0.1	0.1
Mercury	EPA 1631 E	NE	NE	NE	0.012	1.5	0.012	2.1	0.025	1.8	0.77	1.4	0.94	1.8	0.41	0.0004[10]	0.025
Silver	EPA 6020A ICP-MS	NE	25,926	NE	22	170	NE	3.4	NE	1.9	NE	3.2	NE	1.9	6.1	0.2	0.2
Zinc	EPA 6020A ICP-MS	26,000	16,548	NE	56	1,400	104	114	81	90	120	120	81	90	410	4.0	4.0
Polychlorinated Biphenyls (PCBs)																	
Aroclor 1016	EPA 8082	NE	0.00585	0.00299	0.000023	0.00072	NE	NE	NE	NE	NE	NE	NE	NE	NE	0.01	0.02
Aroclor 1221	EPA 8082	NE	NE	NE	NE		NE	NE	NE	NE	NE	NE	NE	NE	NE	0.01	0.02
Aroclor 1232	EPA 8082	NE	NE	NE	NE		NE	NE	NE	NE	NE	NE	NE	NE	NE	0.01	0.02
Aroclor 1242	EPA 8082	NE	NE	NE	0.000023	0.00072	NE	NE	NE	NE	NE	NE	NE	NE	NE	0.01	0.02
Aroclor 1248	EPA 8082	NE	NE	NE	0.000023	0.22	NE	NE	NE	NE	NE	NE	NE	NE	NE	0.01	0.02
Aroclor 1254	EPA 8082	NE	0.00167	0.000105	0.0000055	0.00029	NE	NE	NE	NE	NE	NE	NE	NE	NE	0.01	0.02
Aroclor 1260	EPA 8082	NE	NE	NE	0.000023	0.0054	NE	NE	NE	NE	NE	NE	NE	NE	NE	0.01	0.02
Aroclor 1262	EPA 8082	NE	NE	NE	NE		NE	NE	NE	NE	NE	NE	NE	NE	NE	0.01	0.02
Aroclor 1268	EPA 8082	NE	NE	NE	NE		NE	NE	NE	NE	NE	NE	NE	NE	NE	0.01	0.02
Total PCBs	EPA 8082	0.000064	NE	0.000105	0.000023	0.0018	0.014	2	0.03	10	0.014	NE	0.03	NE	0.13[11]/12 mg/kg-OC[12]	0.09[13]	0.18[13]

NOTES:

Indicates selected screening level value for groundwater and stormwater.
Indicates selected screening level value for catch basin solids.
Indicates selected screening level value for soil.
Indicated Jorgensen Forge NPDES benchmark values for stormwater.

[1] Washington State and national water quality criteria for the protection of human health are the same. Human health criteria are based on dissolved concentrations for all chemicals for marine water for ingestion of organisms only (not water).
[2] Ecology Cleanup Levels and Risk Calculations (CLARC) under the Model Toxics Control Act (MTCA) Cleanup Regulation, Standard Method B Formula Values for Surface Water, November 2001.
[3] The Boeing Plant 2 TMCLs are presented in the Boeing Plant 2, Seattle, WA, Target Media Cleanup Levels Technical Memorandum prepared by The Boeing Company for EPA dated May 26, 2011.
[4] The aquatic life criteria for metals are for the dissolved fraction, except the Washington State WQC for chronic freshwater and marine mercury.
[5] Ecology Water Quality Standards for Surface Waters of the State of Washington, Toxic Substances Criteria for Freshwater and Marine Water, Chronic Toxicity, Chapter 173-201A of the Washington Administrative Code, November 2006.
[6] EPA National Water Quality Criteria for Surface Waters the protection of aquatic life in freshwater and marine water, Section 304(a) of the Clean Water Act, 2009.
[7] EPA Action Memorandum, Responsiveness Summary and Future Actions, Jorgensen Forge Early Action Area, October 2011.
[8] Screening level shown is for Chromium (III).
[9] Screening level shown is for Chromium (VI).
[10] Sample will be sent from ARI to Brooks Rand Laboratory for analysis.
[11] These RvALs were established based on SQS values, which are presented in units of mg/kg OC. The OC normalized units were converted to mg/kg dw using a TOC concentration of 1.55%, reflecting the average TOC concentration in the T-117 Sediment Study Area based on both surface and subsurface sample results. For outside the range of acceptability for TOC normalization (0.5 to 4.0%), then the LAET (upon which the SQS is based) in dry-weight units of 0.13 mg/kg can be applied as a surrogate value.
[12] PCB data are normalized for total organic carbon content by dividing the sample concentration in mg/kg by the percent fraction of total organic carbon content of the sediment sample.
[13] Boeing Plant 2 TMCL values are less than the laboratory practical detection limit, therefore, the practical detection limit is used as the screening level.

µg/l = micrograms per liter
AWQC = ambient water quality criteria
CCC = criteria continuous concentration
CLARC = Cleanup Levels and Risk Calculations
CMC = criteria maximum concentration
Ecology = Washington State Department of Ecology
EPA = U.S. Environmental Protection Agency
ICP-MS = inductively coupled plasma mass spectrometry
LDW = Lower Duwamish Waterway
LOQ = Limits of Quantitation
mg/kg = milligrams per kilogram
NE = not established
NPDES = National Pollutant Discharge Elimination System
OC = organic carbon normalized
RvAL = removal action level
TMCL = target media cleanup level
TSC = Toxic Substances Criteria
WQC = water quality criteria

Farallon will notify EPA at least 4 weeks prior to scheduling stormwater monitoring events to accommodate EPA participation, if requested. The stormwater samples will be collected from the official effluent sample location used by Jorgensen Forge for Industrial Stormwater General Permit No. WAR-003231 at Outfall 003 (Figure 1).

Stormwater samples will be collected downstream of the stormwater treatment system. The concentrations of COCs detected in the stormwater samples will be compared to concentrations of COCs detected in the sediments samples collected in the vicinity of stormwater discharge through Outfall 003 as defined in the BODR OMMP. The analytical results for the sediments samples collected from sampling location LTR-4 will be used to compare with the analytical results for the stormwater samples to evaluate whether stormwater is a source of contamination to the LDW (Figure 1).

7.1 STORMWATER SAMPLING PROCEDURES

Stormwater samples will be collected in accordance with the Washington State Department of Ecology (Ecology) (2010) sampling guidance *How To Do Stormwater Sampling – A Guide For Industrial Facilities* published in December 2002, revised in March 2010, and EPA (1996b) *Method 1669, Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels* published in July 1996, to limit sample contamination due to the low laboratory LOQ for metals.

Stormwater samples will be collected within the first 12 hours of stormwater discharge, or as soon as practicable. Collecting the stormwater samples within 12 hours of a storm event will ensure that the stormwater samples are representative of the effluent discharging from the Jorgensen Forge Facility through the stormwater treatment system. Samples of stormwater from the treatment system effluent sample port will be collected, which is representative of post-treatment system effluent that discharges to the LDW via Outfall 003. The samples collected for dissolved metals will be filtered in the field using a 0.45-micron filter. The HASP provides a description of the health and safety requirements that will be followed during stormwater sampling (Appendix A).

A Stormwater Sample Collection form will be completed by a Field Scientist for each sampling and attempted sampling event (Appendix C). The following information will be recorded for each sampling event:

- Sample date;
- Sample time;
- Notation of whether the sample was collected within the first 12 hours of stormwater discharge;
- Explanation of why a sample could not be collected within the first 12 hours of a stormwater discharge event, if it was not possible;
- Sample location;

- Field sampling results for pH and turbidity;
- Stormwater flow from the stormwater treatment system flow meter;
- Method of sampling and sample preservation, if applicable; and
- Name of the individual who performed the sampling.

7.2 STORMWATER SAMPLE DESIGNATION AND LABELING

The stormwater samples collected for confirmation monitoring will be assigned a unique sample identifier and number. The number will include "SW System Effluent Port" and the date. For example, a stormwater sample collected from the SW System Effluent Port on August 15, 2015 would be numbered SW System Effluent Port-081515. The sample identification will be placed on the sample label, the Stormwater Sample Collection form, and the Chain of Custody form.

Stormwater samples will be submitted to ARI for laboratory analysis for metals, including total and dissolved arsenic, cadmium, chromium, copper, lead, silver, and zinc by EPA Method 6020A; mercury by EPA Method 1631E; PCBs by EPA Method 8082, and total suspended solids (TSS) by Method 2540D. Detailed quantitation goals for precision, recovery, and completeness are provided in Table 1 of the QAPP (Appendix D). Laboratory quality control criteria, including calibration, replicates, matrix spikes, control samples, duplicates, method blanks, and surrogate spike requirements are outlined in Table 2 of the QAPP. Table 4 of the QAPP presents the sample latitude/longitude location, number of samples to be collected, matrix, parameters, sample size, container size and type, holding times, preservation type, and limits of quantitation for the groundwater samples.

8.0 SOLIDS MONITORING AND SAMPLING

The monitoring of solids in the stormwater conveyance system is designed to meet the objectives defined in the Action Memo by providing sufficient data to confirm that solids are not a source of COCs to stormwater discharging to the LDW, potentially recontaminating sediments of the LDW, or causing harmful exposure to benthic organisms. The solids samples will be collected to characterize TSS in stormwater effluent that discharges to the LDW via Outfall 003. Solids data will be compared to sediments data collected from sample location LTR-4 (which was revised to align with Outfall 003) to assess whether solids are a source of COCs to sediments in the RAB.

8.1 SOLIDS SAMPLING PROCEDURES

Solids samples will be collected in accordance with Farallon's standard operating procedures for filtered solids sampling (Appendix B). EMJ will attempt to collect solids by filling a 25 liter carboy plastic container with stormwater from the effluent sample port during the same storm event being sampled for stormwater and transporting the sample to the laboratory, whereby the laboratory will filter the stormwater using a 5-micron filter and analyze any solids collected for the COCs. It is likely that the minimum volume (25 to 30 grams) of solids required by the laboratory to analyze for the COCs cannot feasibly be collected, because TSS has been removed by the treatment system and likely will be very low. First quarter 2015 NPDES TSS sample results ranged from 5 mg/l to less than 10 mg/l with an average of 8.3 mg/l. However, EMJ will make every effort to collect the solids samples. The sampling method proposed will ensure that the solids collected are representative of the effluent discharging from the treatment system. Health and safety requirements for solids sampling are provided in the HASP (Appendix A).

If a sufficient volume of solids has been collected in the filter by the laboratory, the solids will be analyzed for the COCs. If the volume of solids collected in the filter by the laboratory is insufficient for analysis, solids will attempt to be collected again in 3 months and TSS will be monitored for another quarter. If the volume of solids collected in the filter by the laboratory after two consecutive quarters (6 months) is insufficient for analysis, attempts to collect solids will be suspended, and TSS will continue to be monitored quarterly. Additional stormwater collection, filtering by the laboratory, and solids sampling will be attempted again at any time if TSS analytical data suggest that effluent concentrations exceed 30 mg/l, the benchmark for the LDW as impaired and threatened water under the Clean Water Act 303(d) listed water criteria.

For each solids sample collected, a Field Scientist will record the following information:

- Sample date;
- Sample time;
- Sample location;
- Stormwater flow-through from the dedicated sampler flow meter;

- Method of sampling and sample preservation, if applicable; and
- Name of the individual who performed the sampling.

8.2 SOLIDS SAMPLE DESIGNATION AND LABELING

The solids number will include “Solids” and the date. For example, a solids sample collected on August 15, 2015 would be numbered Solids-081515. The sample identification will be placed on the sample label, recorded in the field notes, and on the Chain of Custody form.

The solids samples collected will be submitted to ARI for laboratory analysis for metals, including total arsenic, cadmium, chromium, copper, lead, silver, and zinc by EPA Method 6020A; mercury by EPA Method 1631E; PCBs by EPA Method 8082, and Total Organic Carbon by EPA Method 415.1. Detailed quantitation goals for precision, recovery, and completeness are included in Table 1 of the QAPP (Appendix D). Laboratory quality control criteria, including calibration, replicates, matrix spikes, control samples, duplicates, method blanks, and surrogate spike requirements are outlined in Table 2 of the QAPP. Table 4 of the QAPP presents a list of the sample latitude/longitude location, number of samples to be collected, matrix, parameters, sample size, container size and type, holding times, preservation type, and limits of quantitation for the solids samples.

9.0 DATA EVALUATION AND REPORTING

Groundwater and stormwater monitoring reports will be incorporated into the OMMP monitoring report after the Year 1 and Year 3 monitoring events. A stand-alone Year 2 OMMP monitoring report summarizing the groundwater and stormwater monitoring results obtained to that point in time will be prepared after the Year 2 monitoring events. Each monitoring report will be prepared and submitted to EPA within 90 days of receipt of final validated analytical results for that event. The reports will include a description and evaluation of the monitoring activities conducted during the monitoring year. Follow-up meetings with EMJ and EPA will be scheduled as necessary to review and discuss the monitoring results, particularly to agree on a path forward if contingency response actions are required. The monitoring reports will include the information described in OMMP Section 7 at a minimum, summarized below.

Jorgensen Forge Corporation will be performing a Remedial Investigation on the upland portion of the Jorgensen Forge Facility starting in 2015. Pertinent data collected during the Remedial Investigation by Jorgensen Forge Corporation will be used, as necessary, to further supplement monitoring data collected by EMJ from 2015 to 2018.

9.1 SCREENING LEVEL VALUES

Screening level values were developed after discussion with EPA and Ecology, review of literature and documents, and evaluation of potentially applicable laws and regulations to define concentrations for the COCs that are considered protective of sediment quality in the LDW and consistent with Boeing . Where use of sediments screening level values was inappropriate, screening level values protective of surface water quality in the LDW were used. The screening level values protective of sediment quality were preferentially selected over screening levels protective of surface water quality, given the focus on sediment quality. Screening level values were established for groundwater as protective of sediment quality, for stormwater as protective of surface water, and for soil protective of aquatic species exposed to groundwater. The screening level values for the COCs are included in Table 5.

9.2 GENERAL REPORTING

Each monitoring report will generally contain the following information:

- A summary of the field activities, including a description of deviations from the OMMP and the Addendum to the OMMP and the reasons for the deviations;
- A Final Quality Assurance/Quality Control (QA/QC) report to ensure that data quality is sufficient to meet project objectives and support project decisions; and
- Electronic (PDF) copies of relevant field and analytical data forms and reports, including QA/QC data, a data validation report, a data table of the validated groundwater and stormwater monitoring data, and an evaluation.

9.2.1 Groundwater Monitoring

The following groundwater monitoring and sampling information will be included in the OMMP monitoring reports:

- Figures drawn to scale that depict the surveyed monitoring well locations, groundwater analytical results, and surrounding property use;
- A narrative description of the sampling methods and procedures;
- Summary tables of groundwater analytical results presented in comparison to applicable Boeing Plant 2 TMCLs for the LDW and the laboratory LOQ screening levels selected (Table 5); and
- Conclusions regarding the groundwater quality in the shoreline monitoring wells.

9.2.2 Stormwater Monitoring

The following stormwater monitoring and sampling information will be included in the OMMP monitoring reports:

- Figures drawn to scale that depict the stormwater discharge sampling location and location of stormwater drainage system, stormwater analytical results, and surrounding property use;
- A narrative description of the sampling methods and procedures;
- Summary tables of stormwater analytical results presented in comparison to applicable Boeing Plant 2 TMCLs for the LDW and the laboratory LOQ screening levels selected (Table 5); and
- Conclusions regarding the analytical results for COCs in stormwater.

9.2.3 Solids Monitoring

The following solids monitoring and sampling information will be included in the OMMP monitoring reports:

- Figures drawn to scale that depict the solids sampling details, including location and setup;
- Solids analytical results, and surrounding property use;
- A narrative description of the sampling methods and procedures;
- Summary tables of solids analytical results presented in comparison to applicable Sediment RvAL screening levels selected (Table 5); and
- Conclusions regarding the analytical results for COCs in solids.

9.3 DECISION RULES AND CONTINGENCY RESPONSE ACTIONS

Decision rules and contingency response actions are described below for groundwater, stormwater, and solids.

9.3.1 Groundwater

The groundwater data evaluation will include evaluation of the surface sediment samples from from sample locations LTR-1, LTR-2, and LTR-5 (Figure 1) and comparison of the groundwater results to the screening levels. In accordance with the Action Memo, if concentrations of one or more COCs exceeding the screening levels persist in groundwater, the response action will include evaluation of additional measures.

9.3.2 Stormwater

If one or more of the COCs are detected at concentrations exceeding the selected screening levels in a stormwater sample collected for a sampling event, or if concentrations of COCs exceed the selected screening level in the sediments samples collected from LTR-4 (Figure 1), then the stormwater results will be compared to the Jorgensen Forge Facility NPDES permit benchmark values. If the COCs do not exceed the NPDES benchmark values then no additional response actions will be evaluated. If one or more of the COCs exceed the NPDES benchmark values, then additional measures will be evaluated consistent with the Action Memo.

9.3.3 Solids

If one or more of the COCs are detected at concentrations exceeding the selected screening levels in a solids sample collected for a sampling event, or if concentrations of COCs exceed the selected screening level in the sediment samples collected from LTR-4 (Figure 1), then additional measures will be evaluated consistent with the Action Memo.

10.0 REFERENCES

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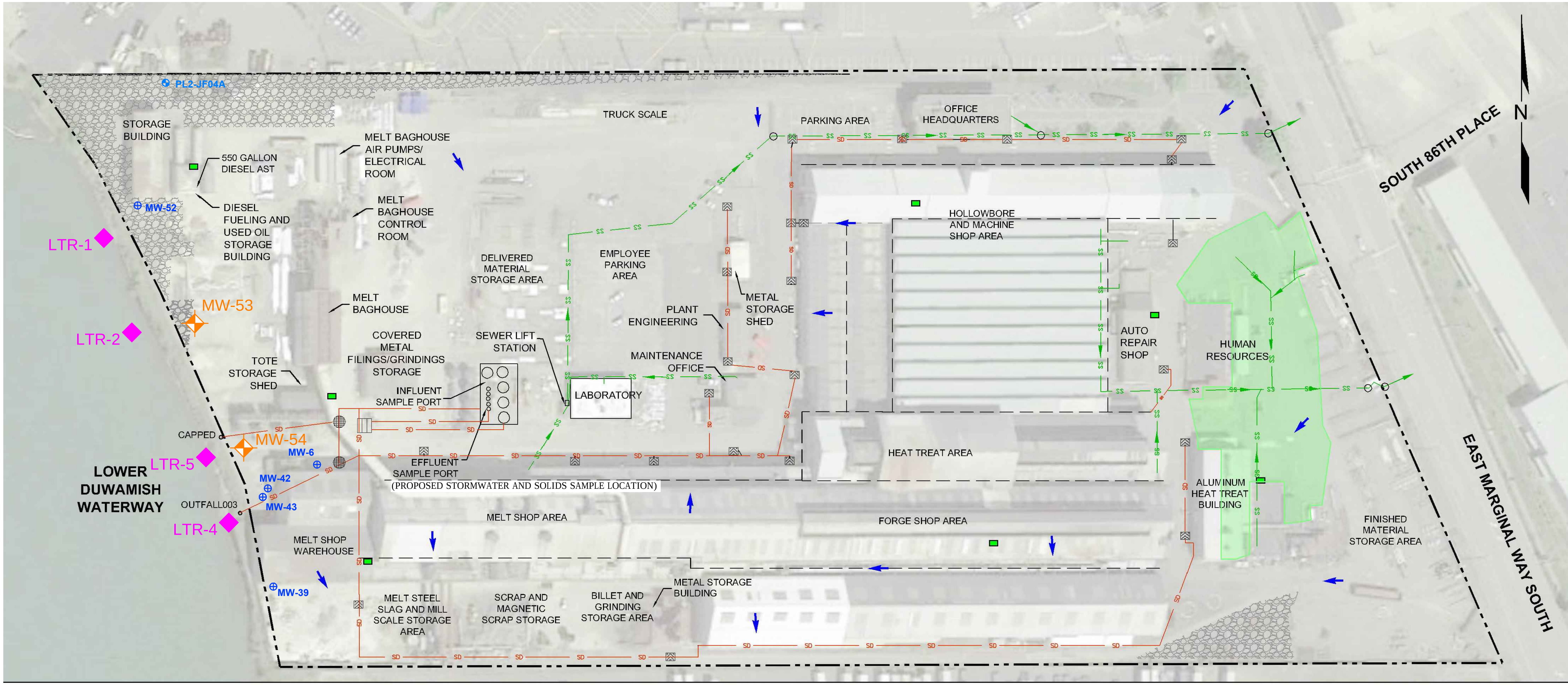
FIGURE

ADDENDUM NO. 1 TO THE OPERATIONS, MONITORING, AND MAINTENANCE PLAN, BASIS OF DESIGN REPORT
Jorgensen Forge Early Action Area Removal Action
U.S. Environmental Protection Agency Docket No. CERCLA-10-2013-0032
Seattle, Washington

Farallon PN: 831-032



LEGEND

PROPERTY BOUNDARY	GRAVEL SURFACE (PERVIOUS)	SPILL KIT LOCATION	PROPOSED MONITORING WELL
STORMWATER PIPE	SANITARY SEWER DRAINAGE AREA	STORMWATER COLLECTION VAULT	PROPOSED SURFACE SEDIMENT SAMPLING LOCATION
ROOF CONVEYANCE	STORMWATER FLOW ARROW	CATCH BASIN	
SANITARY SEWER PIPE AND FLOW DIRECTION		MANHOLE	
	MW-39	MONITORING WELL	
	PL2-JF04A	BOEING MONITORING WELL	

0 110
Scale in feet

NOTE:
STRUCTURES AND FEATURES SHOWN ON THIS FIGURE WERE NOT VERIFIED BY SURVEY BY SOUNDEARTH STRATEGIES INC. LOCATIONAL INFORMATION HAS BEEN ADAPTED FROM APPENDIX C OF THE ENGINEERING REPORT DRAFTED BY ANCHOR QEA, LLC.

FIGURE PROVIDED BY SOUND EARTH STRATEGIES DATED APRIL 08, 2014

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Washington
Issaquah | Bellingham | Seattle
Oregon
Portland
California
Oakland | Sacramento

FIGURE 1

PROPOSED GROUNDWATER AND STORMWATER COMPLIANCE SAMPLING LOCATIONS
BASIS OF DESIGN REPORT OPERATIONS, MONITORING, AND MAINTENANCE PLAN ADDENDUM
JORGENSEN FORGE EAA REMOVAL ACTION

FARALLON PN: 831-032

Drawn By: DEW | Checked By: AED | Date: 5/8/2015 | Disk Reference: 831032

TABLES

ADDENDUM NO. 1 TO THE OPERATIONS, MONITORING, AND MAINTENANCE PLAN, BASIS OF DESIGN REPORT
Jorgensen Forge Early Action Area Removal Action
U.S. Environmental Protection Agency Docket No. CERCLA-10-2013-0032
Seattle, Washington

Farallon PN: 831-032

Table 1
Project Schedule for Soil, Groundwater, Stormwater, and Catch Basin Solids Sampling
Jorgensen Forge Removal Action
Seattle, Washington
Farallon PN: 831-032

Sampling Event	2015		2016				2017				2018	
	3rd Qtr	4th Qtr	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	1st Qtr	2nd Qtr
MONITORING WELL INSTALLATION AND SOIL SAMPLING												
Well Installation and Development and Soil Sampling												
Soil Sample Analysis (contingent on groundwater results)												
GROUNDWATER SAMPLING												
1st Sampling Event (2015)												
2nd Sampling Event (2016)												
3rd Sampling Event (2017)												
STORMWATER AND SOLIDS SAMPLING												
1st Sampling Event (2015)												
2nd Sampling Event (2015)												
3rd Sampling Event (2016)												
4th Sampling Event (2016)												
5th Sampling Event (2016)												
6th Sampling Event (2016)												
7th Sampling Event (2017)												
8th Sampling Event (2017)												
9th Sampling Event (2017)												
10th Sampling Event (2017)												
11th Sampling Event (2018)												
12th Sampling Event (2018)												

NOTE:
Sampling schedule is an estimate and subject to change. The U.S. Environmental Protection Agency will be notified in writing if there are any modifications to the proposed schedule.

Table 2
Minimum, Mean, Maximum, and Selected Screening Level Values - Groundwater and Stormwater
Jorgensen Forge Removal Action
Seattle, Washington
Farallon PN: 831-032

			Metals															
			Total (µg/l)								Dissolved (µg/l)							
Media	Statistic and SL Selected	Total PCBs (µg/l)	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Silver	Zinc	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Silver	Zinc
Groundwater (2003 to 2011)	min (includes non-detects)	0.01 U	0.2	0.011 U	1 U	0.15 U	0.034 U	0.00016	0.007	1.5 U	0.174	0.011 U	0.024	0.15	0.034 U	0.00016 U	0.006 U	1.1 U
	mean (includes non-detects)	0.6	6.11	2.72	9.57	6.57	1.43	0.18	3.32	24.74	1.21	2.22	5.81	1.71	1.55	0.04	0.87	13.44
	max (includes non-detects)	4.3	92	10 U	120	36	17	0.5 U	10 U	150	20 U	10 U	20 U	20 U	10 U	0.5 U	10 U	150 U
	SL selected[1]	0.09[2]	NE	NE	NE	NE	NE	NE	NE	NE	8.0	0.25	0.58[3]	8.0	2.5	0.012	22	56
	# of total samples	47	183	181	173	132	183	184	184	184	90	92	94	95	90	93	93	112
	# of non-detect samples	36	86	178	153	127	173	177	176	159	35	91	74	59	88	92	88	94
Stormwater (2013 to current)	min (includes non-detects)	0.01 U	1 U	1 U	1 U	5 U	0.9	0.1 U	1 U	5 U	1 U	1 U	1 U	5 U	1 U	0.1 U	1 U	5 U
	mean (includes non-detects)	0.0214	1.78	1.0	10.30	16.00	2.40	0.16	1.00	252.00	1.75	1	8.44	12.50	1.90	0.16	1	268.00
	max (includes non-detects)	0.1 U	3.05	1 U	44.6	47	8.29	1 U	1 U	640	3.4	1 U	34	47.4	9.27	1 U	1 U	632
	SL selected[1]	0.09[2]	NE	NE	NE	NE	NE	NE	NE	NE	8.0	0.25	0.58[3]	8.0	2.5	0.012	22	56
	# of total samples	20	20	8	20	27	27	20	6	27	18	6	18	19	19	18	4	19
	# of non-detect samples	16	4	8	2	5	10	20	6	1	4	6	2	7	15	18	4	2

NOTES:

[1]The Boeing Plant 2 TMCLs are presented in the technical memorandum regarding Boeing Plant 2, Seattle, WA, Target Media Cleanup Levels dated May 26, 201, prepared by The Boeing Company for EPA 1.

[2]Boeing Plant 2 TMCL values are less than the laboratory limit of quantitation; therefore, the limit of quantitation is used as the screening level.

[3]Screening level shown is for Chromium (VI).

µg/l = micrograms per liter
max = maximum
min = minimum
NA = not applicable
NE = not established
PCBs = polychlorinated biphenyls
SL = screening level
U = no detectable concentrations exceeding the listed laboratory practical quantitation limit

Table 3
Summary of Soil Analytical Results for Metals Along the Shoreline
Jorgensen Forge Removal Action
Seattle, Washington
Farallon PN: 831-032

Sample Location	Sample Identification	Sample Depth (feet bgs)	Sample Date	Sampled by	Analytical Results (milligrams per kilogram) [1]							
					Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Silver	Zinc
Surface Soil												
5-1	Unknown	0	3/1/1990	Dames and Moore	2	1.15	**37**	—	57.7	0.05	0.2 U	—
9-1	Unknown	0	3/1/1990	Dames and Moore	2	1.75	**914**	—	25.5	0.04 U	0.2 U	—
9-2	Unknown	0	3/1/1990	Dames and Moore	3	2.58	**6,500**	—	25.9	0.04 U	0.2 U	—
9-3	Unknown	0	3/1/1990	Dames and Moore	3	2.98	**1,910**	—	32.4	0.04 U	1.6	—
9-4	Unknown	0	3/1/1990	Dames and Moore	3	**4.92**	**504**	—	**282**	0.05	1.1	—
16-1	Unknown	0	3/1/1990	Dames and Moore	6	**4.31**	**1,740**	—	69.4	0.04 U	1.1	—
16-2	Unknown	0	3/1/1990	Dames and Moore	5	2.33	**913**	—	67.9	0.04 U	0.87	—
DM-B-12	Unknown	13.5	3/1/1990	Dames and Moore	4	1.3	**9**	—	0.98 U	0.04 U	0.2 U	—
DM-B-15	Unknown	10	2/28/1990	Dames and Moore	3	0.9	**8**	—	29.4	0.04 U	0.2 U	—
DM-B-16	Unknown	11.5	2/28/1990	Dames and Moore	2	0.8	**6**	—	1 U	0.04 U	0.2 U	—
MW-39	Unknown	6.3	2/11/2009	Unknown	12 U	1.8	**1,000**	**140**	**290**	0.29 U	0.9	260
	Unknown	10	2/11/2009		14 U	0.68 U	**1,100**	66	200	0.34 U	0.82	230
SB1	Unknown	0 - 2	8/26/2004	Farallon	**25.7**	**4.5**	**515**	**334 B2**	111 B2	0.065	0.281 J	1,320 B2
	Unknown	2 - 4	8/26/2004		5.98	1.06 U	**209**	59.6 B2	20.8 B2	0.0501	0.136 J	129 B2
SB2	Unknown	0 - 2	8/26/2004	Farallon	16.6	1.15 U	**829**	**169 B2**	226 B2	0.0542	0.421 J	370 B2
	Unknown	2 - 4	8/26/2004		14.6	1.06 U	**707**	**104 B2**	**278 B2**	0.0205 U	0.351 J	231 B2
	Unknown	4 - 6	8/26/2004		9.47	0.283 U	**588 B2**	74.5	**323**	0.0074 J	0.381	215 B2
	Unknown	6 - 8	8/26/2004		8.14	0.265 U	**618 B2**	**115**	**274**	0.0192 U	0.325	162 B2
SB3	Unknown	0 - 2	8/26/2004	Farallon	**20.3**	2.2	**282**	**156 B2**	**1,530 B2**	0.0422	0.379 J	476 B2
	Unknown	2 - 4	8/26/2004		**61.7**	1.02 U	**1,170**	**541 B2**	95.4 B2	0.0193 U	0.171 J	118 B2
	Unknown	4 - 6	8/26/2004		**20.1**	0.266 U	**765 B2**	**188**	180	0.0058 J	0.28	197 B2
	Unknown	6 - 8	8/26/2004		7.65	0.252 U	**772 B2**	72.9	179	0.009 J	0.274	191 B2
SB4	Unknown	0 - 2	8/26/2004	Farallon	14.1	0.584 J	**507**	**216 B2**	**1,130 B2**	0.694	0.381 J	319 B2
	Unknown	2 - 4	8/26/2004		9.17	1.1 U	**476**	72.9 B2	**312 B2**	0.123	0.372 J	230 B2
	Unknown	4 - 6	8/26/2004		16	0.289 U	**666 B2**	**171**	732	0.0239 U	0.4	200 B2
	Unknown	6 - 8	8/26/2004		7.67	0.288 U	**691 B2**	68.8	**460**	0.0352	0.332	136 B2
SB5	Unknown	0 - 2	8/26/2004	Farallon	3.47	0.967 U	**560**	40.2 B2	109 B2	0.0128 J	0.188 J	102 B2
	Unknown	2 - 4	8/26/2004		6.44	1.25 U	**961**	77.3 B2	**327 B2**	0.0208 J	0.331 J	289 B2
	Unknown	4 - 6	8/26/2004		3.75	0.282 U	**799 B2**	69.1	192	0.0098 J	0.259 J	255 B2
	Unknown	6 - 8	8/26/2004		9.1	0.319 U	**889 B2**	**102**	**256**	0.0244 U	0.35	253 B2
SB6	Unknown	0 - 2	8/27/2004	Farallon	7.25	0.892 U	**593**	**220 B2**	96 B2	0.0226	0.65 J	267 B2
	Unknown	2 - 4	8/27/2004		**62.7**	0.0799 J	**1,170**	**955 B2**	112 B2	0.0055 J	0.627 J	87 B2
	Unknown	4 - 6	8/27/2004		**33.4**	0.219 U	**1,550 B2**	**717**	132	0.0183 U	0.747	110 B2
	Unknown	6 - 8	8/27/2004		19.1	0.252 U	**606 B2**	**264**	92.9	0.0159 U	0.315	100 B2
SB7	Unknown	0 - 2	8/27/2004	Farallon	8.47	1.09 U	**3,200**	**262 B2**	110 B2	0.0192 J	0.553 J	170 B2
	Unknown	2 - 4	8/27/2004		15.8	1.97	**410**	**130 B2**	**543 B2**	0.0673	1 J	507 B2
	Unknown	4 - 6	8/27/2004		15.1	3.19	**1,950 B2**	**271**	**1,460**	0.118	1.61	1,380 B2
	Unknown	6 - 8	8/27/2004		14.2	0.446	**1,000 B2**	**205**	**657**	0.0573	1.39	414 B2

Table 3
Summary of Soil Analytical Results for Metals Along the Shoreline
Jorgensen Forge Removal Action
Seattle, Washington
Farallon PN: 831-032

Sample Location	Sample Identification	Sample Depth (feet bgs)	Sample Date	Sampled by	Analytical Results (milligrams per kilogram) [1]							
					Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Silver	Zinc
SB-18	Unknown	2	2/5/2009	Unknown	12 U	0.6 U	**14**	13	6 U	0.3 U	0.6 U	26
	Unknown	4	2/5/2009		13 U	0.66 U	**9.5**	13	6.6 U	0.33 U	0.66 U	20
	Unknown	6	2/5/2009		14 U	0.72 U	**18**	26	7.3	0.36 U	0.72 U	41
SB-19	Unknown	2	2/5/2009	Unknown	11 U	0.57 U	**87**	44	46	0.28 U	0.57 U	160
	Unknown	4	2/5/2009		12 U	0.59 U	**16**	23	33	0.29 U	0.59 U	110
	Unknown	6	2/5/2009		13 U	0.63 U	**14**	19	6.3 U	0.32 U	0.63 U	30
SS1	083104-1140-03	0-2	8/31/2004	Farallon	**24.7**	**6.73 B2**	**350**	**183 B2**	**1,010**	0.0681	1.69 B2	986 B2
SS2	083104-1200-04	0-2	8/31/2004	Farallon	18.8	**4.11 B2**	**117**	**246 B2**	**3,330**	0.958	0.784 J B2	**1,710 B2**
	083104-1215-05	0-2	8/31/2004	Farallon	**22.5**	**6.66 B2**	**133**	**179 B2**	**5,010**	0.866	0.867 J B2	**2,700 B2**
SS3	083004-1230-06	0-2	8/30/2004	Farallon	10.3	0.303 J B1	**57.9**	72.4 B2	**313**	0.0311	1.03 U	196 B2
SS4	083004-1215-05	0-2	8/30/2004	Farallon	9.95	0.517 U	**386**	**83.7 B2**	146	0.0128 J	0.839 J B2	159 B2
SS5	083004-1145-04	0-2	8/30/2004	Farallon	15.4	0.479 U	**91.8**	**220 B2**	246	0.03	0.957 U	178 B2
SS6	083004-1055-03	0-2	8/30/2004	Farallon	**31.8**	2.11 B2	**182**	**361 B2**	**4,210**	0.145	0.461 J B1	**2,350 B2**
SS7	083004-1040-02	0-2	8/30/2004	Farallon	**64.9**	11.6 B2	**227**	**561 B2**	**5,450**	0.502	8.73 B2	**5,430 B2**
SS8	083004-1020-01	0-2	8/30/2004	Farallon	12.2	2.24 B2	**28**	**104 B2**	109	0.0928	1.03 U	1,170 B2
North Debris Pile	083104-1240-07	0-2	8/31/2004	Farallon	**23.6**	0.598 U	**309**	**484 B2**	**9,180**	0.182	1.2 U	**2,140 B2**
South Debris Pile	083104-1230-06	0-2	8/31/2004	Farallon	**53.9**	0.587 U	**229**	**1,100 B2**	**1,040**	0.0449	1.17 U	314 B2
Jorgensen Forge Outfall Site Vertical Characterization												
T1B1	JF-T1B1-SO-03	3-5	1/14/2011	Boeing	7	0.4	—	**3,830**	24	—	—	68
	JF-T1B1-SO-08	8-10	1/14/2011		7 U	0.3 U	—	21.2	3 U	—	—	25
	JF-T1B1-SO-13	13-15	1/14/2011		7 U	0.3	—	16.9	3 U	—	—	245
T1B2	JF-T1B2-SO-03	3-5	1/14/2011	Boeing	6 U	0.2 U	—	17.5	4	—	—	28
	JF-T1B2-SO-03-D	3-5	1/14/2011		6 U	0.2 U	—	14.5	4	—	—	28
	JF-T1B2-SO-08	8-10	1/14/2011		6 U	0.2 U	—	17.6	3	—	—	29
	JF-T1B2-SO-13	13-15	1/14/2011		7 U	0.3 U	—	18.2	3 U	—	—	26
T1B3	JF-T1B3-SO-03	3-5	1/14/2011	Boeing	5 U	0.3	—	45.7	7	—	—	53
	JF-T1B3-SO-08	8-10	1/14/2011		6	1.1	—	70.5	11	—	—	126
	JF-T1B3-SO-18	18.5-20	1/14/2011		12	**38.2**	—	257	**1,330**	—	—	**2,720**
T1B4	JF-T1B4-SO-03	3-5	1/14/2011	Boeing	120 U	**87**	—	**55,900**	**2,850**	—	—	**5,270**
	JF-T1B4-SO-12	12-14	1/14/2011		6 U	0.8	—	59.4	11	—	—	83
	JF-T1B4-SO-18	18-20	1/14/2011		6 U	0.2 U	—	9.5	5	—	—	57
T1B3	T1B3-18-20-121206	18-20	12/6/2012	Anchor	0.2 U	0.01 U	0.02 U	—	0.1	0.0001 U	0.02 U	—
T2B4	T2B4-15-20-121206	15-20	12/6/2012	Anchor	0.2 U	0.04	0.02 U	—	0.4	0.0001 U	0.02 U	—
	T2B4-23-24.5-121206	23-24.5	12/6/2012		0.2 U	0.01	0.02 U	—	0.1 U	0.000 1 U	0.02 U	—
T2B1	JF-T2B1-SO-03	3-5	1/13/2011	Boeing	6 U	0.4	**17.4**	—	8	—	—	42
	JF-T2B1-SO-08	8-10	1/13/2011		6	0.2 U	**20.9**	—	6	—	—	36
	JF-T2B1-SO-13	13-15	1/13/2011		7 U	0.4	**20.5**	—	3 U	—	—	35

Table 3
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Jorgensen Forge Removal Action
Seattle, Washington
Farallon PN: 831-032

Sample Location	Sample Identification	Sample Depth (feet bgs)	Sample Date	Sampled by	Analytical Results (milligrams per kilogram) [1]							
					Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Silver	Zinc
T2B2	JF-T2B2-SO-03	3-5	1/13/2011	Boeing	19	0.3	**44.5**	—	36	—	—	67
	JF-T2B2-SO-08	8-10	1/13/2011		7	0.3	**25.7**	—	46	—	—	79
	JF-T2B2-SO-13	13-15	1/13/2011		6 U	0.3 U	**17**	—	5	—	—	695
T2B3	JF-T2B3-SO-02	2-4	1/13/2011	Boeing	8	0.4	**37.8**	—	22	—	—	119
	JF-T2B3-SO-08	8-10	1/13/2011		8	0.3	**43.3**	—	31	—	—	59
	JF-T2B3-SO-13	13-15	1/13/2011		7	0.3	**30.6**	—	30	—	—	60
T2B4	JF-T2B4-SO-03	3-5	1/13/2011	Boeing	8	0.8	**48.2**	—	87	—	—	225
	JF-T2B4-SO-18	18-20	1/13/2011		14	**29.4**	**668**	—	**886**	—	—	**5,630**
	JF-T2B4-SO-23	23-25	1/13/2011		**180**	2.1	**209**	—	300	—	—	**1,520**
T3B1	JF-T3B1-SO-03	3-5	1/13/2011	Boeing	6 U	0.2 U	—	15.4	2 U	—	—	26
	JF-T3B1-SO-08	8-10	1/13/2011		6 U	0.2 U	—	14.7	2	—	—	34
	JF-T3B1-SO-13	13-15	1/13/2011		7	0.3 U	—	29.2	3	—	—	37
T3B2	JF-T3B2-SO-03	3-5	1/13/2011	Boeing	5 U	0.2 U	—	16.3	7	—	—	42
	JF-T3B2-SO-08	8-10	1/13/2011		6 U	0.3 U	—	22	3	—	—	31
	JF-T3B2-SO-13	13-15	1/13/2011		6 U	0.3 U	—	24.9	3	—	—	37
	JF-T3B2-SO-13-D	13-15	1/13/2011		6 U	0.2 U	—	25.1	3	—	—	39
T3B3	JF-T3B3-SO-03	3-5	1/13/2011	Boeing	6 U	2.1	—	62.6 J	27	—	—	116 J
	JF-T3B3-SO-08	8-10	1/13/2011		20 U	**6.5**	—	**354**	208	—	—	**6,960**
	JF-T3B3-SO-13	13-15	1/13/2011		6 U	0.5	—	38.8	24	—	—	525
T3B4	JF-T3B4-SO-03	3-5	1/13/2011	Boeing	10 U	**6.9**	—	**111**	**259**	—	—	472
	JF-T3B4-SO-13	13-15	1/13/2011		7	0.2 U	—	51.8	7	—	—	142
	JF-T3B4-SO-23	23-25	1/13/2011		6 U	0.2 U	—	10.5	2 U	—	—	29
Selected Screening Level Values[2]					**20**	**4**	**1.2**	**80**	**250**	**1.5**	**170**	**1,400**

NOTES:

— denotes sample not analyzed

Results in **bold** denote that sample results exceeding selected screening level values.

[1]Analyzed by U.S. Environmental Protection Agency (EPA) 6000/7000 Series Methods.

[3]The Boeing Plant 2 TMCLs are presented in the technical memorandum regarding Boeing Plant 2, Seattle, WA, Target Media Cleanup Levels dated May 26, 2011, prepared by The Boeing Company for EPA.

Anchor = Anchor QEA, LLC.
bgs = below ground surface
Boeing = The Boeing Company
B2 = The analyte was detected in the associated method blank at a level less than 1/10 the sample concentration.
Dames and Moore = Dames and Moore, Inc.
Farallon = Farallon Consulting, L.L.C.
J = the analyte was analyzed for and positively identified, but the associated numerical value is an estimated quantity
SECOR = SECOR International, Inc.
U = no detectable concentrations exceeding the listed laboratory practical quantitation limit
UJ = estimated detection limit
Weston = Weston Solutions, Inc.

Table 4
Summary of Soil Analytical Results for Polychlorinated Biphenyls Along the Shoreline
Jorgensen Forge Removal Action
Seattle, Washington
Farallon PN: 831-032

Sample Location	Sample Identification	Sample Depth (feet bgs)	Sample Date	Sampled by	Analytical Results (milligrams per kilogram) [1] Aroclor 1016	1016/1242	1221	1232	1242	1248	1254	1260	1262	1268	Total PCBs
Subsurface Soil Samples															
PL2-JF04A	Unknown	6 - 8	2/16/2005	Weston	0.046 U	—	0.046 U	0.046 U	0.046 U	0.046 U	0.046 U	0.046 U	—	—	0.046 U
		8 - 10	2/16/2005		0.046 U	—	0.046 U	0.046 U	0.046 U	0.046 U	0.046 U	0.046 U	—	—	0.046 U
		10 - 12	2/16/2005		0.045 U	—	0.045 U	0.045 U	0.045 U	0.045 U	0.045 U	0.045 U	—	—	0.045 U
		12 - 14	2/16/2005		0.044 U	—	0.044 U	0.044 U	0.044 U	0.044 U	0.044 U	0.044 U	—	—	0.044 U
		14 - 16	2/16/2005		0.044 U	—	0.044 U	0.044 U	0.044 U	0.044 U	0.044 U	0.044 U	—	—	0.044 U
		16 - 18	2/16/2005		0.043 U	—	0.043 U	0.043 U	0.043 U	0.043 U	0.043 U	0.043 U	—	—	0.043 U
SB-07228	Unknown	0 - 2	6/10/2003	Weston	0.036 U	—	0.073 U	0.036 U	0.036 U	0.036 U	0.056	0.054 UJ	0.044 U	0.044	0.1
		2 - 4	6/10/2003		0.037 U	—	0.073 U	0.037 U	0.037 U	0.037 U	0.2	0.039 UJ	0.044 U	0.037 U	**0.2**
		4 - 6	6/10/2003		0.038 U	—	0.076 U	0.038 U	0.038 U	0.038 U	0.038 U	0.038 U	0.046 U	0.038 U	0.076 U
		6 - 8	6/10/2003		0.045 U	—	0.089 U	0.045 U	0.045 U	0.045 U	0.045 U	0.045 U	0.054 U	0.045 U	0.089 U
		8 - 10	6/10/2003		0.045 U	—	0.09 U	0.045 U	0.045 U	0.045 U	0.045 U	0.045 U	0.054 U	0.045 U	0.09 U
		10 - 12	6/10/2003		0.044 U	—	0.087 U	0.044 U	0.044 U	0.044 U	0.053 UJ	0.1	0.052 U	0.044 U	0.1
		12 - 14	6/10/2003		0.048 U	—	0.096 U	0.048 U	0.048 U	0.048 U	0.048 U	0.034 J	0.057 U	0.048 U	0.034 J
		14 - 16	6/10/2003		0.043 U	—	0.085 U	0.043 U	0.043 U	0.043 U	0.043 U	0.043 U	0.051 U	0.043 U	0.085 U
SB-07232r	Unknown	6 - 8	2/14/2005	Weston	0.037 U	—	0.037 U	0.037 U	0.037 U	0.037 U	0.037 U	0.037 U	—	—	0.037 U
		8 - 10	2/14/2005		0.047 U	—	0.047 U	0.047 U	0.047 U	0.047 U	0.047 U	0.047 U	—	—	0.047 U
		10 - 12	2/14/2005		0.049 U	—	0.049 U	0.049 U	0.049 U	0.049 U	0.049 U	0.049 U	—	—	0.049 U
		12 - 14	2/14/2005		0.046 U	—	0.046 U	0.046 U	0.046 U	0.046 U	0.046 U	0.046 U	—	—	0.046 U
		14 - 16	2/14/2005		0.044 U	—	0.044 U	0.044 U	0.044 U	0.044 U	0.044 U	0.088 UY	—	—	0.088 UY
SB-07233r	Unknown	6 - 8	2/14/2005	Weston	0.044 U	—	0.044 U	0.044 U	0.044 U	0.044 U	0.044 U	0.220 UY	—	—	0.220 UY
		8 - 10	2/14/2005		0.044 U	—	0.088 UY	0.130 UY	0.088 UY	0.044 U	0.130 UY	0.220 UY	—	—	0.220 UY
		10 - 12	2/14/2005		0.046 U	—	0.046 U	0.046 U	0.046 U	0.046 U	0.046 U	0.046 U	—	—	0.046 U
		12 - 14	2/14/2005		0.044 U	—	0.044 U	0.044 U	0.044 U	0.044 U	0.044 U	0.044 U	—	—	0.044 U
		14 - 16	2/14/2005		0.044 U	—	0.044 U	0.044 U	0.044 U	0.044 U	0.044 U	0.044 U	—	—	0.044 U
SB-07234	Unknown	0 - 2	6/10/2003	Weston	0.034 U	—	0.069 U	0.034 U	0.034 U	0.034 U	0.03 J	0.052	0.034 U	0.034 U	0.082 J
		2 - 4	6/10/2003		0.038 U	—	0.075 U	0.038 U	0.038 U	0.038 U	0.038 U	0.038 U	0.038 U	0.038 U	0.075 U
		4 - 6	6/10/2003		0.04 U	—	0.08 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.08 U
		6 - 8	6/10/2003		0.043 U	—	0.087 U	0.043 U	0.043 U	0.043 U	0.043 U	0.043 U	0.043 U	0.043 U	0.087 U
		8 - 10	6/10/2003		0.039 U	—	0.078 U	0.039 U	0.039 U	0.039 U	0.025 J	0.039 U	0.039 U	0.039 U	0.078 U
		10 - 12	6/10/2003		0.043 U	—	0.087 U	0.043 U	0.043 U	0.043 U	0.045	0.062	0.043 U	0.043 U	0.107
		12 - 14	6/10/2003		0.043 U	—	0.086 U	0.043 U	0.043 U	0.043 U	0.043 U	0.043 U	0.043 U	0.043 U	0.086 U
		14 - 16	6/10/2003		0.042 U	—	0.084 U	0.042 U	0.042 U	0.042 U	0.042 U	0.042 U	0.042 U	0.042 U	0.084 U
SB-07245	Unknown	0 - 0	6/10/2003	Weston	0.038 U	—	0.075 U	0.038 U	0.038 U	0.038 U	0.072	0.038 U	0.045 U	0.038 U	0.072
		0 - 2	6/10/2003		0.042 U	—	0.085 U	0.042 U	0.042 U	0.042 U	0.042 U	0.042 U	0.051 U	0.042 U	0.085 U
		2 - 4	6/10/2003		0.038 U	—	0.077 U	0.038 U	0.038 U	0.038 U	0.038 U	0.038 U	0.046 U	0.038 U	0.077 U
		4 - 6	6/10/2003		0.038 U	—	0.075 U	0.038 U	0.038 U	0.038 U	0.038 U	0.038 U	0.045 U	0.038 U	0.075 U
		6 - 8	6/10/2003		0.042 U	—	0.085 U	0.042 U	0.042 U	0.042 U	0.042 U	0.042 U	0.051 U	0.042 U	0.085 U
		8 - 10	6/10/2003		0.039 U	—	0.079 U	0.039 U	0.039 U	0.039 U	0.039 U	0.039 U	0.047 U	0.039 U	0.079 U
		10 - 12	6/10/2003		0.044 U	—	0.088 U	0.044 U	0.044 U	0.044 U	0.023 J	0.044 U	0.053 U	0.044 U	0.088 U
		12 - 14	6/10/2003		0.042 U	—	0.085 U	0.042 U	0.042 U	0.042 U	0.047	0.042 U	0.051 U	0.042 U	0.047

Table 4
Summary of Soil Analytical Results for Polychlorinated Biphenyls Along the Shoreline
Jorgensen Forge Removal Action
Seattle, Washington
Farallon PN: 831-032

					Analytical Results (milligrams per kilogram) [1]										
					Aroclor										
Sample Location	Sample Identification	Sample Depth (feet bgs)	Sample Date	Sampled by	1016	1016/1242	1221	1232	1242	1248	1254	1260	1262	1268	Total PCBs
SB-07246	Unknown	0 - 0	6/10/2003	Weston	0.036 U	—	0.072 U	0.036 U	0.036 U	0.036 U	0.036 U	0.13	0.036 U	0.071	**0.201**
		0 - 2	6/10/2003		0.036 U	—	0.072 U	0.036 U	0.036 U	0.036 U	0.036 U	0.036 U	0.036 U	0.036 U	0.072 U
		2 - 4	6/10/2003		0.039 U	—	0.078 U	0.039 U	0.039 U	0.039 U	0.039 U	0.039 U	0.039 U	0.039 U	0.078 U
		4 - 6	6/10/2003		0.037 U	—	0.074 U	0.037 U	0.037 U	0.037 U	0.051	0.061	0.037 U	0.027 J	0.139 J
		8 - 10	6/10/2003		0.044 U	—	0.089 U	0.044 U	0.044 U	0.044 U	0.044 U	0.044 U	0.044 U	0.044 U	0.089 U
		10 - 12	6/10/2003		0.047 U	—	0.095 U	0.047 U	0.047 U	0.047 U	0.047 U	0.047 U	0.047 U	0.047 U	0.095 U
		12 - 14	6/10/2003		0.046 U	—	0.091 U	0.046 U	0.046 U	0.046 U	0.046 U	0.046 U	0.046 U	0.046 U	0.091 U
SB1	Unknown	0 - 2	8/26/2004	Farallon	0.0101 U	—	0.0101 U	0.0101 U	0.0101 U	0.0101 U	0.0908 C1	0.105 C1	—	—	**0.1958**
		2 - 4	8/26/2004		0.0103 U	—	0.0103 U	0.0103 U	0.0103 U	0.0103 U	0.0103 U	0.007 J C1	—	—	0.007 J
		4 - 6	8/26/2004		0.0109 U	—	0.0109 U	0.0109 U	0.0109 U	0.0109 U	0.0109 U	0.0035 J C1	—	—	0.0035 J
		6 - 8	8/26/2004		0.0095 U	—	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	—	—	0.00568 J
		8 - 10	8/26/2004		0.0113 U	—	0.0113 U	0.0113 U	0.0113 U	0.0113 U	0.0113 U	0.00568 J C1	—	—	0.0057
		10 - 12	8/26/2004		0.0136 U	—	0.0136 U	0.0136 U	0.0136 U	0.0136 U	0.0136 U	0.0136 U	—	—	0.0136 U
SB2	Unknown	0 - 2	8/26/2004	Farallon	0.0111 U	—	0.0111 U	0.0111 U	0.0111 U	0.0111 U	0.396 C1	0.0111 U	—	—	**0.3960**
		2 - 4	8/26/2004		0.0113 U	—	0.0113 U	0.0113 U	0.0113 U	0.0113 U	0.0937 C1	0.0251 C1	—	—	0.1188
		4 - 6	8/26/2004		0.0116 U	—	0.0116 U	0.0116 U	0.0116 U	0.0116 U	0.0294 C1	0.0148 C1	—	—	0.0442
		6 - 8	8/26/2004		0.0111 U	—	0.0111 U	0.0111 U	0.0111 U	0.0111 U	0.0282 C1	0.0155 C1	—	—	0.0437
		8 - 10	8/26/2004		0.0125 U	—	0.0125 U	0.0125 U	0.0125 U	0.0125 U	0.0125 U	0.00618 J C1	—	—	0.00618 J
		10 - 12	8/26/2004		0.0106 U	—	0.0106 U	0.0106 U	0.0106 U	0.0106 U	0.415 C1	0.253 C1	—	—	**0.6680**
		12 - 14	8/26/2004		0.0102 U	—	0.0102 U	0.0102 U	0.0102 U	0.0102 U	0.00606 J C1	0.0102 U	—	—	0.0061
		14 - 16	8/26/2004		0.0114 U	—	0.0114 U	0.0114 U	0.0114 U	0.0114 U	0.0114 U	0.0114 U	—	—	0.00606 J
SB3	Unknown	0 - 2	8/26/2004	Farallon	0.524 U	—	0.524 U	0.524 U	0.524 U	0.524 U	15.5 C1	2.27 C1	—	—	**17.77**
		2 - 4	8/26/2004		0.0098 U	—	0.0098 U	0.0098 U	0.0098 U	0.0098 U	0.174 C1	0.0323 C1	—	—	**0.2063**
		4 - 6	8/26/2004		0.0103 U	—	0.0103 U	0.0103 U	0.0103 U	0.0103 U	0.194 C1	0.0334 C1	—	—	**0.2274**
		6 - 8	8/26/2004		0.0116 U	—	0.0116 U	0.0116 U	0.0116 U	0.0116 U	0.22 C1	0.0385 C1	—	—	**0.2585**
		8 - 10	8/26/2004		0.0117 U	—	0.0117 U	0.0117 U	0.0117 U	0.0117 U	0.156 C1	0.0695 C1	—	—	**0.2255**
SB4	Unknown	0 - 2	8/26/2004	Farallon	0.202 U	—	0.202 U	0.202 U	0.202 U	0.202 U	5.93 C1	0.904 C1	—	—	**6.834**
		2 - 4	8/26/2004		0.0562 U	—	0.0562 U	0.0562 U	0.0562 U	0.0562 U	1.15 C1	0.774 C1	—	—	**1.924**
		4 - 6	8/26/2004		0.587 U	—	0.587 U	0.587 U	0.587 U	0.587 U	9.86 C1	1.47 C1	—	—	**11.33**
		6 - 8	8/26/2004		0.0114 U	—	0.0114 U	0.0114 U	0.0114 U	0.0114 U	0.32 C1	0.0768 C1	—	—	**0.3968**
		8 - 10	8/26/2004		0.0118 U	—	0.0118 U	0.0118 U	0.0118 U	0.0118 U	0.328 C1	0.107 C1	—	—	**0.4350**
		10 - 12	8/26/2004		0.0124 U	—	0.0124 U	0.0124 U	0.0124 U	0.0124 U	0.0127 C1	0.00935 J C1	—	—	0.02205 J
		12 - 14	8/26/2004		0.22 U	—	0.22 U	0.22 U	0.22 U	0.22 U	6.01 C1	1.03 C1	—	—	**7.04**
		14 - 16	8/26/2004		0.118 U	—	0.118 U	0.118 U	0.118 U	0.118 U	1.37 C1	0.19 C1	—	—	**1.56**
SB5	Unknown	0 - 2	8/26/2004	Farallon	0.0102 U	—	0.0102 U	0.0102 U	0.0102 U	0.0102 U	0.0267 C1	0.00801 J C1	—	—	0.03471 J
		2 - 4	8/26/2004		0.0122 U	—	0.0122 U	0.0122 U	0.0122 U	0.0122 U	0.00778 J C1	0.00713 J C1	—	—	0.01491 J
		4 - 6	8/26/2004		0.0112 U	—	0.0112 U	0.0112 U	0.0112 U	0.0112 U	0.049 C1	0.014 C1	—	—	0.063
		6 - 8	8/26/2004		0.011 U	—	0.011 U	0.011 U	0.011 U	0.011 U	0.0116 C1	0.00851 J C1	—	—	0.02011 J
		8 - 10	8/26/2004		0.0114 U	—	0.0114 U	0.0114 U	0.0114 U	0.0114 U	0.0967 C1	0.0875 C1	—	—	**0.1842**
		10 - 12	8/26/2004		0.012 U	—	0.012 U	0.012 U	0.012 U	0.012 U	0.0528 C1	0.0725 C1	—	—	0.1253
		12 - 14	8/26/2004		0.0111 U	—	0.0111 U	0.0111 U	0.0111 U	0.0111 U	0.0505 C1	0.0724 C1	—	—	0.1229
		14 - 16	8/26/2004		0.0128 U	—	0.0128 U	0.0128 U	0.0128 U	0.0128 U	0.0745 C1	0.0989 C1	—	—	0.1734

Table 4
Summary of Soil Analytical Results for Polychlorinated Biphenyls Along the Shoreline
Jorgensen Forge Removal Action
Seattle, Washington
Farallon PN: 831-032

Sample Location	Sample Identification	Sample Depth (feet bgs)	Sample Date	Sampled by	Analytical Results (milligrams per kilogram) [1]										
					Aroclor										
					1016	1016/1242	1221	1232	1242	1248	1254	1260	1262	1268	Total PCBs
SB6	Unknown	0 - 2	8/27/2004	Farallon	0.0099 U	—	0.0099 U	0.0099 U	0.0099 U	0.0099 U	0.0594 C1	0.0782 C1	—	—	0.1376
		2 - 4	8/27/2004		0.0095 U	—	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0905 C1	0.0673 C1	—	—	0.1578
		4 - 6	8/27/2004		0.01 U	—	0.01 U	0.01 U	0.01 U	0.01 U	0.122 C1	0.0605 C1	—	—	**0.1825**
		6 - 8	8/27/2004		0.0097 U	—	0.0097 U	0.0097 U	0.0097 U	0.0097 U	0.145 C1	0.0584 C1	—	—	**0.2034**
		8 - 10	8/27/2004		0.0101 U	—	0.0101 U	0.0101 U	0.0101 U	0.0101 U	0.0935 C1	0.113 C1	—	—	**0.2065**
		10 - 12	8/27/2004		0.0103 U	—	0.0103 U	0.0103 U	0.0103 U	0.0103 U	0.172 C1	0.0938 C1	—	—	**0.2658**
		12 - 14	8/27/2004		0.0106 U	—	0.0106 U	0.0106 U	0.0106 U	0.0106 U	0.133 C1	0.0523 C1	—	—	**0.1853**
		14 - 16	8/27/2004		0.0103 U	—	0.0103 U	0.0103 U	0.0103 U	0.0103 U	0.0404 C1	0.0503 C1	—	—	0.0907
SB7	Unknown	0 - 2	8/27/2004	Farallon	0.0102 U	—	0.0102 U	0.0102 U	0.0102 U	0.0102 U	0.0683 C1	0.0293 C1	—	—	0.0976
		2 - 4	8/27/2004		0.0105 U	—	0.0105 U	0.0105 U	0.0105 U	0.0105 U	0.256 C1	0.0952 C1	—	—	**0.3512**
		4 - 6	8/27/2004		0.054 U	—	0.054 U	0.054 U	0.054 U	0.054 U	1.13 C1	0.493 C1	—	—	**1.623**
		6 - 8	8/27/2004		0.0099 U	—	0.0099 U	0.0099 U	0.0099 U	0.0099 U	0.251 C1	0.114 C1	—	—	**0.365**
		8 - 10	8/27/2004		0.011 U	—	0.011 U	0.011 U	0.011 U	0.011 U	0.323 C1	0.0967 C1	—	—	**0.4197**
		10 - 12	8/27/2004		0.0119 U	—	0.0119 U	0.0119 U	0.0119 U	0.0119 U	0.21 C1	0.0924 C1	—	—	**0.3024**
		12 - 14	8/27/2004		0.0111 U	—	0.0111 U	0.0111 U	0.0111 U	0.0111 U	0.253 C1	0.128 C1	—	—	**0.381**
		14 - 16	8/27/2004		0.0124 U	—	0.0124 U	0.0124 U	0.0124 U	0.0124 U	0.204 C1	0.425 C1	—	—	**0.629**
SS1	083104-1140-03	0-2	8/31/2004	Farallon	0.011 U	—	0.011 U	0.011 U	0.011 U	0.011 U	0.152 C1	0.171 C1	—	—	**0.323**
SS2	083104-1200-04	0-2	8/31/2004	Farallon	0.103 U	—	0.103 U	< 0.103	< 0.103	< 0.103	2.92 C1	0.767 C1	—	—	**3.687**
	083104-1215-05	0-2	8/31/2004	Farallon	0.105 U	—	0.105 U	0.105 U	0.105 U	0.105 U	3.15 C1	0.95 C1	—	—	**4.1**
SS3	083004-1230-06	0-2	8/30/2004	Farallon	0.0519 U	—	0.0519 U	0.0519 U	0.0519 U	0.0519 U	1.02 C1	0.423 C1	—	—	**1.443**
SS4	083004-1215-05	0-2	8/30/2004	Farallon	0.0102 U	—	0.0102 U	0.0102 U	0.0102 U	0.0102 U	0.0118 C1	0.0137 C1	—	—	0.0255
SS5	083004-1145-04	0-2	8/30/2004	Farallon	0.0105 U	—	0.0105 U	0.0105 U	0.0105 U	0.0105 U	0.0837 C1	0.113 C1	—	—	**0.1967**
SS6	083004-1055-03	0-2	8/30/2004	Farallon	0.103 U	—	0.103 U	0.103 U	0.103 U	0.103 U	2.78 C1	1.76 C1	—	—	**4.54**
SS7	083004-1040-02	0-2	8/30/2004	Farallon	0.11 U	—	0.11 U	0.11 U	0.11 U	0.11 U	2.19 C1	1.33 C1	—	—	**3.52**
SS8	083004-1020-01	0-2	8/30/2004	Farallon	0.0101 U	—	0.0101 U	0.0101 U	0.0101 U	0.0101 U	0.0546 C1	0.115 C1	—	—	0.1696
South debris pile	083104-1230-06	0-2	8/31/2004	Farallon	0.118 U	—	0.118 U	0.118 U	0.118 U	0.118 U	1.05 C1	1.01 C1	—	—	**2.06**
North debris pile	083104-1240-07	0-2	8/31/2004	Farallon	0.0603 U	—	0.0603 U	0.0603 U	0.0603 U	0.0603 U	1.94 C1	0.397 C1	—	—	**2.337**
JF-DGP1	JF-DGP1-SO-00'-1.7'	0-1.7	3/29/2012	Anchor	—	—	—	—	—	—	—	—	—	—	—
	JF-DGP1-SO-13.0'-15.6'	13.0-15.6	3/29/2012		2.1 U	2.1 U	2.1 U	2.1 U	43 U	99	13 U	2.1 U	2.1 U	133.3	**99**
	JF-DGP1-SO-17.3'-19.9'	17.3-19.9	3/29/2012		1.4 U	1.4 U	1.4 U	1.4 U	10 U	22	5.7	1.4 U	1.4 U	36.9	**27.7**
	JF-DGP1-SO-21.7'-24.2'	21.7-24.2	3/29/2012		0.039 U	0.039 U	0.039 U	0.039 U	0.049 U	0.13	0.049	0.039 U	0.039 U	0.321	0.179
	JF-DGP1-SO-24.2'-25.8'	24.2-25.8	3/29/2012		0.0037 U	0.0037 U	0.0037 U	0.0037 U	0.0037 U	0.0034 J	0.0037 U	0.0037 U	0.0037 U	0.0182 J	0.0034 J
	JF-DGP1-SO-26.0'-28.6'	26.0-28.6	3/29/2012		0.0039 U	0.0039 U	0.0039 U	0.0039 U	0.0058 U	0.019	0.0044	0.0039 U	0.0039 U	0.038	0.0234
	JF-DGP1-SO-4.3'-6.1'	4.3-6.1	3/29/2012		0.038 U	0.038 U	0.038 U	0.038 U	0.095 U	0.48	0.1	0.038 U	0.038 U	0.742	**0.58**
	JF-DGP1-SO-8.7'-10.8'	8.7-10.8	3/29/2012		1.2 U	1.2 U	1.2 U	1.2 U	4.8 U	21	3.5	1.2 U	1.2 U	30.5	**24.5**

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Seattle, Washington
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Sample Location	Sample Identification	Sample Depth (feet bgs)	Sample Date	Sampled by	Analytical Results (milligrams per kilogram) [1]										
					Aroclor										Total PCBs
					1016	1016/1242	1221	1232	1242	1248	1254	1260	1262	1268	
JF-DGP2	JF-DGP2-SO-00'-02'	0-2	3/29/2012	Anchor	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.18	0.097	0.02 U	0.02 U	0.347	**0.277**
	JF-DGP2-SO-00'-02'	0-2	3/29/2012		—	—	—	—	—	—	—	—	—	—	—
	JF-DGP2-SO-05'-06.5'	5-6.5	3/29/2012		0.45 U	0.45 U	0.45 U	0.45 U	3.4 U	11	2.5	0.45 U	0.45 U	16.55	**13.5**
	JF-DGP2-SO-10'-11.8'	10-11.8	3/29/2012		11 U	11 U	11 U	11 U	120	86	13	11 U	11 U	252	**219**
	JF-DGP2-SO-16'	16	3/29/2012		—	—	—	—	—	—	—	—	—	—	—
	JF-DGP2-SO-15'-17'	15-17	3/29/2012		0.077 U	0.077 U	0.077 U	0.077 U	0.12 U	0.33	0.072 J	0.077 U	0.077 U	0.693 J	0.402 J
	JF-DGP2-SO-17'-19'	17-19	3/29/2012		0.0038 U	0.0038 U	0.0038 U	0.0038 U	0.0038 U	0.0042	0.0038 U	0.0038 U	0.0038 U	0.0194	0.0042
	JF-DGP2-SO-19'-19.8'	19-19.8	3/29/2012		0.0038 U	0.0038 U	0.0038 U	0.0038 U	0.0048 U	0.0094	0.0022 J	0.0038 U	0.0038 U	0.0254 J	0.0116 J
	JF-DGP2-SO-20'-22'	20-22	3/29/2012		0.074 U	0.074 U	0.074 U	0.074 U	0.074 U	0.12	—	0.074 U	0.074 U	0.074 U	0.12
	JF-DGP2-SO-22'-24'	22-24	3/29/2012		0.0038 U	—	0.0038 U	0.0038 U	0.0038 U	0.0047 U	0.0046	0.0038 U	0.0038 U	0.0038 U	0.0046
	JF-DGP2-SO-24'-24.8'	24-24.8	3/29/2012		0.0038 U	—	0.0038 U	0.0038 U	0.0038 U	0.0057 U	0.011	0.0038 U	0.0038 U	0.0038 U	0.011
	JF-DGP2-SO-25'-27'	25-27	3/29/2012		0.079 U	—	0.079 U	0.079 U	0.079 U	0.16 U	0.35	0.079 U	0.079 U	0.079 U	**0.35**
	JF-DGP2-SO-26'	26	3/29/2012		—	—	—	—	—	—	—	—	—	—	—
	JF-DGP2-SO-27'-29'	27-29	3/29/2012		0.078 U	—	0.078 U	0.078 U	0.078 U	0.078 U	0.19	0.078 U	0.078 U	0.078 U	**0.19**
JF-DGP2W	JF-DGP2W-SO-00'-10'	0-10	3/29/2012	Anchor	—	—	—	—	—	—	—	—	—	—	—
	JF-DGP2W-SO-10'-20'	10-20	3/29/2012		—	—	—	—	—	—	—	—	—	—	—
	JF-DGP2W-SO-20'-30'	20-30	3/29/2012		—	—	—	—	—	—	—	—	—	—	—
JF-DGP3	JF-DGP3-SO-00'-02'	0-2	3/28/2012	Anchor	0.0038 U	—	0.0038 U	0.0038 U	0.0038 U	0.0096 U	0.044	0.046	0.0038 U	0.0038 U	0.09
	JF-DGP3-SO-02'-03'	2-3	3/28/2012		0.0038 U	—	0.0038 U	0.0038 U	0.0038 U	0.0038 U	0.0026 J	0.0057 U	0.0038 U	0.0038 U	0.0026 J
	JF-DGP3-SO-05'-07'	5-7	3/28/2012		0.0038 U	—	0.0038 U	0.0038 U	0.0038 U	0.0048 U	0.012	0.0038 U	0.014	0.0038 U	0.026
	JF-DGP3-SO-07'-07.5'	7-7.5	3/28/2012		2.2 U	—	2.2 U	2.2 U	2.2 U	190	110	10 U	2.2 U	2.2 U	**300**
	JF-DGP3-SO-10'-12'	10-12	3/28/2012		2.1 U	—	2.1 U	2.1 U	2.1 U	180	150	29	2.1 U	2.1 U	**359**
	JF-DGP3-SO-15'-16.5'	15-16.5	3/28/2012		0.24 U	—	0.24 U	0.24 U	0.24 U	3.9	5.3	3.1	0.24 U	0.24 U	**12.3**
	JF-DGP3-SO-15'	15	3/28/2012		—	—	—	—	—	—	—	—	—	—	—
	JF-DGP3-SO-20'-21'	20-21	3/28/2012		0.16 U	—	0.16 U	0.16 U	0.16 U	1.8	3.3	1.2	0.16 U	0.16 U	**6.3**
	JF-DGP3-SO-25'-27'	25-27	3/28/2012		0.098 U	—	0.098 U	0.098 U	0.098 U	0.82	1.8	0.67	0.098 U	0.098 U	**3.29**
	JF-DGP3-SO-27'-29'	27-29	3/28/2012		0.074 U	—	0.074 U	0.074 U	0.074 U	0.33	0.69	0.3	0.074 U	0.074 U	**1.32**
	JF-DGP3-SO-27'-29'-D	27-29 Dup	3/28/2012		0.074 U	—	0.074 U	0.074 U	0.074 U	0.26 U	0.57	0.21	0.074 U	0.074 U	**0.78**
	JF-DGP3-SO-30'-32'	30-32	3/28/2012		0.12 U	—	0.12 U	0.12 U	0.12 U	0.9 U	2.4	0.66	0.12 U	0.12 U	**3.06**

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Seattle, Washington
Farallon PN: 831-032

Sample Location	Sample Identification	Sample Depth (feet bgs)	Sample Date	Sampled by	Analytical Results (milligrams per kilogram) [1]										
					Aroclor										
					1016	1016/1242	1221	1232	1242	1248	1254	1260	1262	1268	Total PCBs
JF-DGP4	JF-DGP4-SO-00'-02'	0-2	3/28/2012	Anchor	0.0039 U	—	0.0039 U	0.0039 U	0.0039 U	0.019 U	0.06	0.044	0.0039 U	0.0039 U	0.104
	JF-DGP4-SO-02'-03'	2-3	3/28/2012		0.0038 U	—	0.0038 U	0.0038 U	0.0038 U	0.0038 U	0.0038 J	0.005	0.0038 U	0.0038 U	0.0088 J
	JF-DGP4-SO-05'-07'	5-7	3/28/2012		0.0038 U	—	0.0038 U	0.0038 U	0.0038 U	0.0038 U	0.015	0.0087	0.0038 U	0.0038 U	0.0237
	JF-DGP4-SO-07'-08.75'	7-8.75	3/28/2012		0.0038 U	—	0.0038 U	0.0038 U	0.0038 U	0.028 U	0.12	0.044	0.0038 U	0.0038 U	0.164
	JF-DGP4-SO-10'-12'	10-12	3/28/2012		0.077 U	—	0.077 U	0.077 U	0.077 U	0.31 U	0.75	0.18	0.077 U	0.077 U	**0.93**
	JF-DGP4-SO-12'-13.75'	12-13.75	3/28/2012		0.58 U	—	0.58 U	0.58 U	0.58 U	2.9 U	8.9	0.88 U	0.58 U	0.58 U	**8.9**
	JF-DGP4-SO-15'-17'	15-17	3/28/2012		0.098 U	—	0.098 U	0.098 U	0.098 U	0.49 U	2.3	1.4	0.098 U	0.098 U	**3.7**
	JF-DGP4-SO-17'	17	3/28/2012		—	—	—	—	—	—	—	—	—	—	—
	JF-DGP4-SO-17'-17.5'	17-17.5	3/28/2012		0.26 U	—	0.26 U	0.26 U	0.26 U	1.9 U	5.8	0.64 U	0.26 U	0.26 U	**5.8**
	JF-DGP4-SO-20'-22'	20-22	3/28/2012		0.12 U	—	0.12 U	0.12 U	0.12 U	0.6 U	2.1	0.39	0.12 U	0.12 U	**2.49**
	JF-DGP4-SO-21'	21	3/28/2012		—	—	—	—	—	—	—	—	—	—	—
	JF-DGP4-SO-22'-23.5'	22-23.5	3/28/2012		0.077 U	—	0.077 U	0.077 U	0.077 U	0.38 U	1.3	0.17	0.077 U	0.077 U	**1.47**
	JF-DGP4-SO-25'-27'	25-27	3/28/2012		0.076 U	—	0.076 U	0.076 U	0.076 U	0.47 U	1.7	0.22	0.076 U	0.076 U	**1.92**
	JF-DGP4-SO-25'-27'-D	25-27 Dup	3/28/2012		0.074 U	—	0.074 U	0.074 U	0.074 U	0.37 U	1.4	0.18	0.074 U	0.074 U	**1.58**
	JF-DGP4-SO-26'	26	3/28/2012		—	—	—	—	—	—	—	—	—	—	—
	JF-DGP4-SO-27'-29'	27-29	3/28/2012		0.039 U	—	0.039 U	0.039 U	0.039 U	0.077 U	0.29	0.039 U	0.039 U	0.039 U	**0.29**
	JF-DGP4-SO-29'-29.5'	29-29.5	3/28/2012		0.077 U	—	0.077 U	0.077 U	0.077 U	0.38 U	1.2	0.12 U	0.077 U	0.077 U	**1.2**
	JF-DGP4-SO-30'-32'	30-32	3/28/2012		0.076 U	—	0.076 U	0.076 U	0.076 U	0.19 U	0.64	0.076 U	0.076 U	0.076 U	**0.64**
	JF-DGP4-SO-31'	31	3/28/2012		—	—	—	—	—	—	—	—	—	—	—
	JF-DGP4-SO-32'-34'	32-34	3/28/2012		0.038 U	—	0.038 U	0.038 U	0.038 U	0.38 U	0.71	0.082	0.038 U	0.038 U	**0.792**
	JF-DGP4-SO-33'	33	3/28/2012		—	—	—	—	—	—	—	—	—	—	—
JF-DGP5	JF-DGP5-SO-00'-02'	0-2	3/29/2012	Anchor	0.02 U	—	0.02 U	0.02 U	0.02 U	0.079 U	0.26	0.15	0.02 U	0.02 U	**0.41**
	JF-DGP5-SO-02'	2	3/29/2012		—	—	—	—	—	—	—	—	—	—	—
	JF-DGP5-SO-05'-07'	5-7	3/29/2012		0.076 U	—	0.076 U	0.076 U	0.076 U	0.76 U	1.9	0.23 U	0.076 U	0.076 U	**1.9**
	JF-DGP5-SO-10'-12'	10'12	3/29/2012		0.037 U	—	0.037 U	0.037 U	0.037 U	0.037 U	0.06	0.024 J	0.037 U	0.037 U	0.084 J
	JF-DGP5-SO-12'-14'	12-14	3/29/2012		0.02 U	—	0.02 U	0.02 U	0.02 U	0.02 U	0.02	0.012 J	0.02 U	0.02 U	0.032 J
	JF-DGP5-SO-14'-14.5'	14-14.5	3/29/2012		0.019 U	—	0.019 U	0.019 U	0.019 U	0.019 U	0.028	0.014 J	0.019 U	0.019 U	0.042 J
	JF-DGP5-SO-15'-17'	15-17	3/29/2012		0.019 U	—	0.019 U	0.019 U	0.019 U	0.038 U	0.096	0.019 U	0.019 U	0.019 U	0.096
	JF-DGP5-SO-16'	16	3/29/2012		—	—	—	—	—	—	—	—	—	—	—
	JF-DGP5-SO-17'-19'	17-19	3/29/2012		0.019 U	—	0.019 U	0.019 U	0.019 U	0.053	0.13	0.025	0.019 U	0.019 U	**0.208**
	JF-DGP5-SO-19'-19.8'	19-19.8	3/29/2012		0.038 U	—	0.038 U	0.038 U	0.038 U	0.096 U	0.46	0.21	0.038 U	0.038 U	**0.67**
	JF-DGP5-SO-20'-21.25'	20-21.5	3/29/2012		0.037 U	—	0.037 U	0.037 U	0.037 U	0.19 U	0.84	0.46	0.037 U	0.037 U	**1.3**
	JF-DGP5-SO-25'-27'	25-27	3/29/2012		0.037 U	—	0.037 U	0.037 U	0.037 U	0.15 U	0.49	0.28	0.037 U	0.037 U	**0.77**
	JF-DGP5-SO-26'	26	3/29/2012		—	—	—	—	—	—	—	—	—	—	—
	JF-DGP5-SO-27'-27.5'	27-27.5	3/29/2012		0.037 U	—	0.037 U	0.037 U	0.037 U	0.093 U	0.29	0.052	0.037 U	0.037 U	**0.342**
JF-DGP5W	JF-DGP5W-SO-0'-10'	0-10	3/29/2012	Anchor	—	—	—	—	—	—	—	—	—	—	—
	JF-DGP5W-SO-10'-20'	10-20	3/29/2012		—	—	—	—	—	—	—	—	—	—	—
	JF-DGP5W-SO-20'-30'	20-30	3/29/2012		—	—	—	—	—	—	—	—	—	—	—

Table 4
Summary of Soil Analytical Results for Polychlorinated Biphenyls Along the Shoreline
Jorgensen Forge Removal Action
Seattle, Washington
Farallon PN: 831-032

					Analytical Results (milligrams per kilogram) [1]										
					Aroclor										
Sample Location	Sample Identification	Sample Depth (feet bgs)	Sample Date	Sampled by	1016	1016/1242	1221	1232	1242	1248	1254	1260	1262	1268	Total PCBs
JF-DGP6	JF-DGP6-SO-10'-12'	10-12	3/30/2012	Anchor	0.02 U	—	0.02 U	0.02 U	0.02 U	0.078 U	0.24	0.042	0.02 U	0.02 U	**0.282**
	JF-DGP6-SO-12'-14'	12-14	3/30/2012		2.3 U	—	2.3 U	2.3 U	2.3 U	12 U	42	5.2 U	2.3 U	2.3 U	**42**
	JF-DGP6-SO-15'-17'	15-17	3/30/2012		4.9 U	—	4.9 U	4.9 U	4.9 U	25 U	96	15 U	4.9 U	4.9 U	**96**
	JF-DGP6-SO-17'-19'	17-19	3/30/2012		3 U	—	3 U	3 U	3 U	15 U	43	9.7	3 U	3 U	**52.7**
	JF-DGP6-SO-18.5'	18.5	3/30/2012		—	—	—	—	—	—	—	—	—	—	—
	JF-DGP6-SO-20'-22'	20-22	3/30/2012		0.23 U	—	0.23 U	0.23 U	0.23 U	4.6 U	11	2.2	0.23 U	0.23 U	**13.2**
	JF-DGP6-SO-21'	21	3/30/2012		—	—	—	—	—	—	—	—	—	—	—
	JF-DGP6-SO-22'-24'	22-24	3/30/2012		0.0038 U	—	0.0038 U	0.0038 U	0.0038 U	0.047 U	0.074	0.015	0.0038 U	0.0038 U	0.089
	JF-DGP6-SO-24'-24.5'	24-24.5	3/30/2012		0.0039 U	—	0.0039 U	0.0039 U	0.0039 U	0.0039 U	0.004	0.0039 U	0.0039 U	0.0039 U	0.004
	JF-DGP6-SO-25'-27'	25-27	3/30/2012		0.038 U	—	0.038 U	0.038 U	0.038 U	0.28 U	0.78	0.14	0.038 U	0.038 U	**0.92**
	JF-DGP6-SO-26'	26	3/30/2012		—	—	—	—	—	—	—	—	—	—	—
	JF-DGP6-SO-27'-28.5'	27-28.5	3/30/2012		0.02 U	—	0.02 U	0.02 U	0.02 U	0.032	0.1	0.02 U	0.02 U	0.02 U	0.132
JF-DGS1	JF-DGS1-SO-05'-07'	5-7	3/27/2012	Anchor	0.24 U	—	0.24 U	0.24 U	0.24 U	1.8 U	9.8	0.98 U	0.24 U	0.24 U	**9.8**
	JF-DGS1-SO-10'-12'	10-12	3/27/2012		0.038 U	—	0.038 U	0.038 U	0.038 U	0.28 U	1.3	0.39	0.038 U	0.038 U	**1.69**
	JF-DGS1-SO-15'-17'	15-17	3/27/2012		0.0038 U	—	0.0038 U	0.0038 U	0.0038 U	0.0056 U	0.029	0.017	0.0038 U	0.0038 U	0.046
	JF-DGS1-SO-17'-19'	17-19	3/27/2012		0.0038 U	—	0.0038 U	0.0038 U	0.0038 U	0.0038 U	0.0038 U	0.0038 U	0.0038 U	0.0054	0.0054
	JF-DGS1-SO-20'-22'	20-22	3/27/2012		0.02 U	—	0.02 U	0.02 U	0.02 U	0.049 U	0.26	0.12	0.02 U	0.02 U	**0.38**
	JF-DGS1-SO-25'-27'	25-27	3/27/2012		0.02 U	—	0.02 U	0.02 U	0.02 U	0.049 U	0.25	0.11	0.02 U	0.02 U	**0.36**
	JF-DGS1-SO-30'-32'	30-32	3/27/2012		0.0039 U	—	0.0039 U	0.0039 U	0.0039 U	0.0039 U	0.0039 U	0.0039 U	0.0039 U	0.0039 U	0.0039 U
JF-DGS2	JF-DGS2-SO-05'-07'	5-7	3/28/2012	Anchor	0.0038 U	—	0.0038 U	0.0038 U	0.0038 U	0.0038 U	0.0038 U	0.0038 U	0.0076	0.0038 U	0.0076
	JF-DGS2-SO-10'-12'	10-12	3/28/2012		0.039 U	—	0.039 U	0.039 U	0.039 U	0.039 U	0.39 U	1	0.039 U	0.039 U	**1**
	JF-DGS2-SO-15'-17'	15-17	3/28/2012		0.019 U	—	0.019 U	0.019 U	0.019 U	0.019 U	0.14 U	0.32	0.019 U	0.019 U	**0.32**
	JF-DGS2-SO-20'-22'	20-22	3/28/2012		0.0037 U	—	0.0037 U	0.0037 U	0.0037 UJ	0.0037 UJ	0.0037 UJ	0.0037 UJ	0.0037 U	0.0037 U	0.0037 UJ
JF-DGS3	JF-DGS3-SO-05'-07'	5-7	3/28/2012	Anchor	0.0038 U	—	0.0038 U	0.0038 U	0.0038 UJ	0.0038 UJ	0.0077 UJ	0.0088 J	0.0038 U	0.0038 U	0.0088 J
	JF-DGS3-SO-10'-12'	10-12	3/28/2012		0.0039 U	—	0.0039 U	0.0039 U	0.0039 UJ	0.0039 UJ	0.0099 J	0.0039 UJ	0.0039 U	0.028	0.0379 J
	JF-DGS3-SO-15'-17'	15-17	3/28/2012		0.0036 U	—	0.0036 U	0.0036 U	0.0036 UJ	0.0036 UJ	0.018 UJ	0.06 J	0.0036 U	0.0036 U	0.06 J
	JF-DGS3-SO-20'-22'	20-22	3/28/2012		0.0037 U	—	0.0037 U	0.0037 U	0.0037 UJ	0.0056 UJ	0.018 J	0.032 J	0.0037 U	0.0037 U	0.05 J
	JF-DGS3-SO-24'-24.8'	24-24.8	3/28/2012		0.0038 U	—	0.0038 U	0.0038 U	0.0038 UJ	0.0038 UJ	0.0038 UJ	0.0038 UJ	0.0038 U	0.0038 U	0.0038 UJ
	JF-DGS3-SO-30'-32'	30-32	3/28/2012		0.0036 U	—	0.0036 U	0.0036 U	0.0036 UJ	0.036 UJ	0.036 UJ	0.0045 UJ	0.0036 U	0.0036 U	0.036 UJ

Table 4
Summary of Soil Analytical Results for Polychlorinated Biphenyls Along the Shoreline
Jorgensen Forge Removal Action
Seattle, Washington
Farallon PN: 831-032

					Analytical Results (milligrams per kilogram) [1]										
					Aroclor										
Sample Location	**Sample Identification**	**Sample Depth (feet bgs)**	**Sample Date**	**Sampled by**	**1016**	**1016/1242**	**1221**	**1232**	**1242**	**1248**	**1254**	**1260**	**1262**	**1268**	**Total PCBs**
Jorgensen Forge Outfall Site Vertical Characterization															
T1B1	JF-T1B1-SO-03	3-5	1/14/2011	Boeing	—	—	—	—	0.055 U	0.055 U	0.550 UY	1.6	0.055 U	—	**1.6**
	JF-T1B1-SO-08	8-10	1/14/2011		—	—	—	—	0.004 U	0.004 U	0.0042	0.0078	0.004 U	—	0.012
	JF-T1B1-SO-13	13-15	1/14/2011		—	—	—	—	0.0039 U	0.0039 U	0.0056	0.0039 U	0.0039 U	—	0.0056
T1B2	JF-T1B2-SO-03	3-5	1/14/2011	Boeing	—	—	—	—	0.004 U	0.004 U	0.0051	0.004 U	0.004 U	—	0.0051
	JF-T1B2-SO-03-D	3-5	1/14/2011		—	—	—	—	0.0039 U	0.0039 U	0.0049	0.0039 U	0.0039 U	—	0.0049
	JF-T1B2-SO-08	8-10	1/14/2011		—	—	—	—	0.0039 U	0.0039 U	0.007	0.0039 U	0.0039 U	—	0.007
	JF-T1B2-SO-13	13-15	1/14/2011		—	—	—	—	0.0039 U	0.0039 U	0.0039 U	0.0039 U	0.0039 U	—	0.0039 U
T1B3	JF-T1B3-SO-03	3-5	1/14/2011	Boeing	—	—	—	—	0.0039 U	0.0039 U	0.030 UY	0.07	0.0039	—	0.07
	JF-T1B3-SO-08	8-10	1/14/2011		—	—	—	—	0.041	0.100 UY	0.810 UY	1.8	0.041	—	**1.8**
	JF-T1B3-SO-18	18-20	1/14/2011		—	—	—	—	0.310 U	1.2 UY	3.9	4.2	0.310 U	—	**8.1**
T1B4	JF-T1B4-SO-03	3-5	1/14/2011	Boeing	—	—	—	—	0.0072 UJ	0.025 UJ	0.036 UJ	0.0072 UJ	0.280 J	—	**0.280 J**
	JF-T1B4-SO-12	12-14	1/14/2011		—	—	—	—	0.005	0.050 UY	0.18	0.028	0.0051 U	—	**0.208**
	JF-T1B4-SO-18	18-20	1/14/2011		—	—	—	—	0.0051	0.038 UY	0.11	0.035	0.0051 U	—	**0.145**
T1B3	T1B3-20-22-121206	20-22	12/6/2012	Anchor	0.031 U	—	0.031 U	0.031 U	0.031 U	0.031 U	0.031 U	0.031 U	0.031 U	0.031 U	0.031 U
	T1B3-22-24-121206	22-24	12/6/2012		0.032 U	—	0.032 U	0.032 U	0.032 U	0.032 U	0.032 U	0.032 U	0.032 U	0.032 U	0.032 U
	T1B3-25-27-121206	25-27	12/6/2012		0.032 U	—	0.032 U	0.032 U	0.032 U	0.032 U	0.032 U	0.032 U	0.032 U	0.032 U	0.032 U
	T1B3-30-32-121206	30-32	12/6/2012		0.032 U	—	0.032 U	0.032 U	0.032 U	0.032 U	0.032 U	0.032 U	0.032 U	0.032 U	0.032 U
	T1B3-32-34-121206	32-34	12/6/2012		0.031 U	—	0.031 U	0.031 U	0.031 U	0.031 U	0.031 U	0.031 U	0.031 U	0.031 U	0.031 U
	T1B3-35-37-121206	35-37	12/6/2012		0.032 U	—	0.032 U	0.032 U	0.032 U	0.032 U	0.032 U	0.032 U	0.032 U	0.032 U	0.032 U
	T1B3-37-39-121206	37-39	12/6/2012		0.033 U	—	0.033 U	0.033 U	0.033 U	0.033 U	0.033 U	0.033 U	0.033 U	0.033 U	0.033 U
JFDGP3	JFDGP3-32-34-121206	32-34	12/6/2012	Anchor	0.032 U	—	0.032 U	0.032 U	0.032 U	0.032 U	0.032 U	0.032 U	0.032 U	0.032 U	0.032 U
	JFDGP3-35-37-121206	35-37	12/6/2012		0.032 U	—	0.032 U	0.032 U	0.032 U	0.032 U	0.032 U	0.032 U	0.032 U	0.032 U	0.032 U
	JFDGP3-35-37-121206	35-37	12/6/2012		0.031 U	—	0.031 U	0.031 U	0.031 U	0.031 U	0.031 U	0.031 U	0.031 U	0.031 U	0.031 U
	JFDGP3-37-39-121206	37-39	12/6/2012		0.032 U	—	0.032 U	0.032 U	0.032 U	0.032 U	0.032 U	0.032 U	0.032 U	0.032 U	0.032 U
	JFDGP3-40-42-121206	40-42	12/6/2012		0.031 U	—	0.031 U	0.031 U	0.031 U	0.031 U	0.031 U	0.031 U	0.031 U	0.031 U	0.031 U
T2B4	T2B4-25-27-121206	25-27	12/6/2012	Anchor	0.031 U	—	0.031 U	0.031 U	0.031 U	0.039 U	0.18	0.031 U	0.031 U	0.031 U	**0.18**
	T2B4-27-28.3-121206	27-28.3	12/6/2012		0.130 U	—	0.130 U	0.130 U	0.130 U	0.130 U	0.4	0.130 U	0.130 U	0.130 U	**0.4**
	T2B4-30-32-121206	30-32	12/6/2012		0.120 U	—	0.120 U	0.120 U	0.120 U	0.120 U	0.52	0.120 U	0.120 U	0.120 U	**0.52**
	T2B4-32-33.3-121206	32-33.3	12/6/2012		0.120 U	—	0.120 U	0.120 U	0.120 U	0.120 U	0.39	0.120 U	0.120 U	0.120 U	**0.39**
	T2B4-35-37-121206	35-37	12/6/2012		0.120 U	—	0.120 U	0.120 U	0.120 U	0.120 U	0.56	0.120 U	0.120 U	0.120 U	**0.56**
	T2B4-37-39-121206	37-39	12/6/2012		0.033 U	—	0.033 U	0.033 U	0.033 U	0.033 U	0.09	0.033 U	0.033 U	0.033 U	0.09
	T2B4-40-42-121206	40-42	12/6/2012		0.630 U	—	0.630 U	0.630 U	0.630 U	0.630 U	2.4	0.630 U	0.630 U	0.630 U	**2.4**
	T2B4-40-42-121206	40-42	12/6/2012		0.31 U	—	0.31 U	0.31 U	0.31 U	0.31 U	2.1	0.31 U	0.31 U	0.31 U	**2.1**
T2B1	JF-T2B1-SO-03	3-5	1/13/2011	Boeing	—	—	—	—	0.004 U	0.004 U	0.004 U	0.004 U	0.0098	—	0.0098
	JF-T2B1-SO-08	8-10	1/13/2011		—	—	—	—	0.0039 U	0.0039 U	0.0039 U	0.0039 U	0.0039 U	—	0.0039 U
	JF-T2B1-SO-13	13-15	1/13/2011		—	—	—	—	0.0039 U	0.0039 U	0.0039 U	0.0039 U	0.0039 U	—	0.0039 U
T2B2	JF-T2B2-SO-03	3-5	1/13/2011	Boeing	—	—	—	—	0.0039 U	0.0039 U	0.0039 U	0.0039 U	0.0045	—	0.0045
	JF-T2B2-SO-08	8-10	1/13/2011		—	—	—	—	0.0039 U	0.0039 U	0.0039 U	0.0049 UY	0.0039 U	—	0.0049 UY
	JF-T2B2-SO-13	13-15	1/13/2011		—	—	—	—	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	—	0.004 U
T2B3	JF-T2B3-SO-02	2-4	1/13/2011	Boeing	—	—	—	—	0.0079	0.0079	0.034	0.051	0.0079 U	—	0.085
	JF-T2B3-SO-08	8-10	1/13/2011		—	—	—	—	0.0039 U	0.0039 U	0.0039 U	0.0039 U	0.0067	—	0.0067
	JF-T2B3-SO-13	13-15	1/13/2011		—	—	—	—	0.0039 U	0.0039 U	0.0039 U	0.0039 U	0.004	—	0.004

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Seattle, Washington
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					Analytical Results (milligrams per kilogram)[1]										
					Aroclor										
Sample Location	Sample Identification	Sample Depth (feet bgs)	Sample Date	Sampled by	1016	1016/1242	1221	1232	1242	1248	1254	1260	1262	1268	Total PCBs
T2B4	JF-T2B4-SO-03	3-5	1/13/2011	Boeing	—	—	—	—	0.150 U	0.440 UY	1.3	0.24	0.150 U	—	**1.54**
	JF-T2B4-SO-18	18-20	1/13/2011		—	—	—	—	12 U	120 UY	220	54	120 U	—	**274**
	JF-T2B4-SO-23	23-25	1/13/2011		—	—	—	—	3.9	29	61	11	3.9 U	—	**72**
T3B1	JF-T3B1-SO-03	3-5	1/13/2011	Boeing	—	—	—	—	0.0039 U	0.0039 U	0.0039 U	0.0039 U	0.0039 U	—	0.0039 U
	JF-T3B1-SO-08	8-10	1/13/2011		—	—	—	—	0.0039 U	0.0039 U	0.0039 U	0.0039 U	0.0039 U	—	0.0039 U
	JF-T3B1-SO-13	13-15	1/13/2011		—	—	—	—	0.0085 U	0.017 UY	0.037	0.0085 U	0.028	—	0.065
T3B2	JF-T3B2-SO-03	3-5	1/13/2011	Boeing	—	—	—	—	0.0038 U	0.0038 U	0.0038 U	0.0038 U	0.013 J	—	0.013 J
	JF-T3B2-SO-08	8-10	1/13/2011		—	—	—	—	0.0039 U	0.0039 U	0.0039 U	0.0039 U	0.0039 U	—	0.0039 U
	JF-T3B2-SO-13	13-15	1/13/2011		—	—	—	—	0.0066 U	0.017 UY	0.034	0.0066 U	0.0066U	—	0.034
	JF-T3B2-SO-13-D	13-15	1/13/2011		—	—	—	—	0.0084 U	0.021 UY	0.054	0.0084 U	0.0084 U	—	0.054
T3B3	JF-T3B3-SO-03	3-5	1/13/2011	Boeing	—	—	—	—	0.0085 UJ	0.0085 UJ	0.013 UJ	0.0085 UJ	0.140 J	—	0.140 J
	JF-T3B3-SO-08	8-10	1/13/2011		—	—	—	—	0.020 UJ	0.079 UJ	0.270 J	0.400 J	0.002 UJ	—	**0.67**
	JF-T3B3-SO-13	13-15	1/13/2011		—	—	—	—	0.0088 U	0.0088 U	0.022 UY	0.054 J	0.0088 U	—	0.054 J
T3B4	JF-T3B4-SO-03	3-5	1/13/2011	Boeing	—	—	—	—	0.013 U	0.170 UY	0.54	0.29	0.013 U	—	**0.83**
	JF-T3B4-SO-13	13-15	1/13/2011		—	—	—	—	0.0038 U	0.0038 U	0.017 J	0.011 J	0.0038 U	—	0.028 J
	JF-T3B4-SO-23	23-25	1/13/2011		—	—	—	—	0.0039 U	0.0039 U	0.0045 J	0.0039 U	0.0039 U	—	0.0045 J
BH01	JFOS2-BH01-16	16	10/9/2013	Boeing	<0.4	—	<0.4	<0.4	<0.4	<0.02	15	<0.4	<0.4	<0.4	**15**
	JFOS2-BH01-18	18	10/9/2013		<0.02	—	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
	JFOS2-BH01-20	20	10/9/2013		<0.02	—	<0.02	<0.02	<0.02	<0.02	0.17	<0.02	<0.02	<0.02	0.17
	JFOS2-BH01-22	22	10/9/2013		<0.02	—	<0.02	<0.02	<0.02	<0.02	0.074	<0.02	<0.02	<0.02	0.074
	JFOS2-BH01-24	24	10/9/2013		<0.02	—	<0.02	<0.02	<0.02	<0.02	0.034 js	<0.02	<0.02	<0.02	0.034 js
	JFOS2-BH01-26	26	10/9/2013		—	—	—	—	—	—	—	—	—	—	—
	JFOS2-BH01-28	28	10/9/2013		—	—	—	—	—	—	—	—	—	—	—
	JFOS2-BH01-30	30	10/9/2013		—	—	—	—	—	—	—	—	—	—	—
BH03	JFOS2-BH03-18	18	10/9/2013	Boeing	<4	—	<4	<4	<4	<4	280	<4	<4	<4	**280**
	JFOS2-BH03-20	20	10/9/2013		<4	—	<4	<4	<4	<4	380	180	<4	<4	**560**
	JFOS2-BH03-22	22	10/9/2013		<4	—	<4	<4	<4	<4	<4	110	<4	<4	**110**
	JFOS2-BH03-24	24	10/9/2013		<0.02	—	<0.02	<0.02	<0.02	<0.02	0.18	<0.02	<0.02	<0.02	**0.18**
	JFOS2-BH03-26	26	10/9/2013		<0.4	—	<0.4	<0.4	<0.4	<0.4	<0.4	14	<0.4	<0.4	**14**
	JFOS2-BH03-28	28	10/9/2013		<0.02	—	<0.02	<0.02	<0.02	<0.02	<0.02	0.43	<0.02	<0.02	**0.43**
	JFOS2-BH03-30	30	10/9/2013		<0.02	—	<0.02	<0.02	<0.02	<0.02	<0.02	0.055	<0.02	<0.02	0.055
	JFOS2-BH03-32	32	10/9/2013		<0.02	—	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.02
	JFOS2-BH03-34	34	10/9/2013		<0.02	—	<0.02	<0.02	<0.02	<0.02	0.044	<0.02	<0.02	<0.02	0.044
BH04	JFOS2-BH04-17	17	10/9/2013	Boeing	<4	—	<4	<4	<4	<4	270	<4	<4	<4	**270**
	JFOS2-BH04-19	19	10/9/2013		<4	—	<4	<4	<4	<4	82	<4	<4	<4	—
	JFOS2-BH04-19 (Duplicate)	19	10/9/2013		<4	—	<4	<4	<4	<4	160	<4	<4	<4	**160**
	JFOS2-BH04-21	21	10/9/2013		<2	—	<2	<2	<2	<2	34	<2	<2	<2	**34**
	JFOS2-BH04-23	23	10/9/2013		<10	—	<10	<10	<10	<10	140	<10	<10	<10	**140**
	JFOS2-BH04-30	30	10/9/2013		19	—	<0.4	<0.4	25	<0.4	31	14	4	<0.4	**93**
	JFOS2-BH04-32	32	10/9/2013		<0.02	—	<0.02	<0.02	<0.02	<0.02	0.085	<0.02	<0.02	<0.02	0.085
	JFOS2-BH04-34	34	10/9/2013		<0.02	—	<0.02	<0.02	<0.02	<0.02	0.089	<0.02	<0.02	<0.02	0.089

Table 4
Summary of Soil Analytical Results for Polychlorinated Biphenyls Along the Shoreline
Jorgensen Forge Removal Action
Seattle, Washington
Farallon PN: 831-032

Sample Location	Sample Identification	Sample Depth (feet bgs)	Sample Date	Sampled by	Analytical Results (milligrams per kilogram) [1]										
					Aroclor										Total PCBs
					1016	1016/1242	1221	1232	1242	1248	1254	1260	1262	1268	
BH05	JFOS2-BH05-18	18	10/9/2013	Boeing	<0.2	—	<0.2	<0.2	<0.2	<0.2	2.7	<0.2	<0.2	<0.2	**2.7**
	JFOS2-BH05-20	20	10/9/2013		<0.4	—	<0.4	<0.4	<0.4	<0.4	9.3	<0.4	<0.4	<0.4	—
	JFOS2-BH05-20 (Duplicate)	20	10/9/2013		<0.4	—	<0.4	<0.4	<0.4	<0.4	11	<0.4	<0.4	<0.4	—
	JFOS2-BH05-22	22	10/9/2013		<0.02	—	<0.02	<0.02	<0.02	<0.02	2.9	<0.02	<0.02	<0.02	**2.9**
	JFOS2-BH05-24	24	10/9/2013		<0.02	—	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
	JFOS2-BH05-28	28	10/9/2013		<0.04	—	<0.04	<0.04	<0.04	<0.04	4.9	<0.04	<0.04	<0.04	**4.9**
	JFOS2-BH05-30	30	10/9/2013		1.7	—	<1	<1	<1	<1	<1	27	<1	<1	**29**
	JFOS2-BH05-34	34	10/9/2013		0.085	—	<0.02	<0.02	<0.02	<0.02	<0.02	1.9	<0.02	<0.02	**2**
	JFOS2-BH05-35	35	10/9/2013		<0.1	—	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Selected Screening Level Values[2]					**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**0.18**

NOTES:
— denotes sample not analyzed
Results in **bold** denote that sample results exceed selected screening level values.
[1]Analyzed by U.S. Environmental Protection Agency (EPA) Method 8080, 8081, or 8082.
[2]Boeing Plant 2 TMCL values are less than the laboratory practical detection limit; therefore, the practical detection limit is used as the screening level. The Boeing Plant 2 TMCLs are presented in the Boeing Plant 2, Seattle, WA, Target Media Cleanup Levels Technical Memorandum prepared by The Boeing Company for EPA dated May 26, 2011.

Anchor = Anchor QEA, LLC.
bgs = below ground surface
Boeing = The Boeing Company
C1 = Second column confirmation was performed. The relative percent difference between the two column results was below 40%.
Farallon = Farallon Consulting, L.L.C.
H = denotes value greater than minimum shown.
J = the analyte was analyzed for and positively identified, but the associated numerical value is an estimated quantity.
NE = not established
SECOR = SECOR International, Inc.
U = no detectable concentrations exceeding the listed laboratory practical quantitation limit
UJ = estimated detection limit
Weston = Weston Solutions, Inc.
Y = The analyte reporting limit is raised due to a positive chromatographic interference. The compound is not detected exceeding the raised limit but may be present at or less than the limit.

Table 5
Screening Level Values and Laboratory Limits of Quantitation - Groundwater, Stormwater, Catch Basin Solids, and Soil
Jorgensen Forge Removal Action
Seattle, Washington
Farallon PN: 831-032

		Screening Levels															
		Human Health Criteria for Consumption of Organisms[1]	Ecology MTCA Method B Standard Formula Values for Surface Water [2]		Boeing Plant 2 (EPA Proposed TMCL for LDW)[3]	Boeing Plant 2 (EPA Proposed TMCL for LDW)[3]	Aquatic Life Criteria[4]								RvALs[7]	Laboratory LOQ Groundwater and Stormwater	Sediment, Soil, and Stormwater Solids Laboratory LOQ (mg/kg wet weight)
							Washington State WQC[5]				National AWQC[6]						
							Freshwater		Marine		Freshwater		Marine				
Parameter	Analytical Method	Groundwater (µg/l)	Non-Carcinogenic (µg/l)	Carcinogenic (µg/l)	Groundwater and Surface Water (µg/l)	Soil (mg/kg)	Chronic (µg/l)	Acute (µg/l)	Chronic (µg/l)	Acute (µg/l)	CCC (µg/l)	CMC (µg/l)	CCC (µg/l)	CMC (µg/l)	Sediments (mg/kg dry weight)	Total and Dissolved (µg/l)	
Metals																	
Arsenic	EPA 6020A ICP-MS	0.14	17.7	0.0982	8.0	20	190	360	36	69	150	340	36	69	57	0.2	0.2
Cadmium	EPA 6020A ICP-MS	NE	40.5	NE	0.25	4.0	1	3.7	9.3	42	0.25	2	8.8	40	5.1	0.1	0.1
Chromium	EPA 6020A ICP-MS	NE	243,000[8]	NE	0.58	1.2	10[9]	15[9]	50[9]	1,100[9]	11[9]	16[9]	50[9]	1,100[9]	260[9]	0.5	0.5
Copper	EPA 6020A ICP-MS	NE	2,880	NE	8.0	80	11.4	17	3.1	4.8	9	13	3.1	4.8	390	0.5	0.5
Lead	EPA 6020A ICP-MS	NE	NE	NE	2.5	250	2.5	65	8.1	210	2.5	65	8.1	210	450	0.1	0.1
Mercury	EPA 1631 E	NE	NE	NE	0.012	1.5	0.012	2.1	0.025	1.8	0.77	1.4	0.94	1.8	0.41	0.0004[10]	0.025
Silver	EPA 6020A ICP-MS	NE	25,926	NE	22	170	NE	3.4	NE	1.9	NE	3.2	NE	1.9	6.1	0.2	0.2
Zinc	EPA 6020A ICP-MS	26,000	16,548	NE	56	1,400	104	114	81	90	120	120	81	90	410	4.0	4.0
Polychlorinated Biphenyls (PCBs)																	
Aroclor 1016	EPA 8082	NE	0.00585	0.00299	0.000023	0.00072	NE	NE	NE	NE	NE	NE	NE	NE	NE	0.01	0.02
Aroclor 1221	EPA 8082	NE	NE	NE	NE		NE	NE	NE	NE	NE	NE	NE	NE	NE	0.01	0.02
Aroclor 1232	EPA 8082	NE	NE	NE	NE		NE	NE	NE	NE	NE	NE	NE	NE	NE	0.01	0.02
Aroclor 1242	EPA 8082	NE	NE	NE	0.000023	0.00072	NE	NE	NE	NE	NE	NE	NE	NE	NE	0.01	0.02
Aroclor 1248	EPA 8082	NE	NE	NE	0.000023	0.22	NE	NE	NE	NE	NE	NE	NE	NE	NE	0.01	0.02
Aroclor 1254	EPA 8082	NE	0.00167	0.000105	0.0000055	0.00029	NE	NE	NE	NE	NE	NE	NE	NE	NE	0.01	0.02
Aroclor 1260	EPA 8082	NE	NE	NE	0.000023	0.0054	NE	NE	NE	NE	NE	NE	NE	NE	NE	0.01	0.02
Aroclor 1262	EPA 8082	NE	NE	NE	NE		NE	NE	NE	NE	NE	NE	NE	NE	NE	0.01	0.02
Aroclor 1268	EPA 8082	NE	NE	NE	NE		NE	NE	NE	NE	NE	NE	NE	NE	NE	0.01	0.02
Total PCBs	EPA 8082	0.000064	NE	0.000105	0.000023	0.0018	0.014	2	0.03	10	0.014	NE	0.03	NE	0.13[11]/12 mg/kg-OC[12]	0.09[13]	0.18[13]

NOTES:

Indicates selected screening level value for groundwater and stormwater.
Indicates selected screening level value for catch basin solids.
Indicates selected screening level value for soil.
Indicated Jorgensen Forge NPDES benchmark values for stormwater.

[1]Washington State and national water quality criteria for the protection of human health are the same. Human health criteria are based on dissolved concentrations for all chemicals for marine water for ingestion of organisms only (not water).
[2]Ecology Cleanup Levels and Risk Calculations (CLARC) under the Model Toxics Control Act (MTCA) Cleanup Regulation, Standard Method B Formula Values for Surface Water, November 2001.
[3]The Boeing Plant 2 TMCLs are presented in the Boeing Plant 2, Seattle, WA, Target Media Cleanup Levels Technical Memorandum prepared by The Boeing Company for EPA dated May 26, 2011.
[4]The aquatic life criteria for metals are for the dissolved fraction, except the Washington State WQC for chronic freshwater and marine mercury.
[5]Ecology Water Quality Standards for Surface Waters of the State of Washington, Toxic Substances Criteria for Freshwater and Marine Water, Chronic Toxicity, Chapter 173-201A of the Washington Administrative Code, November 2006.
[6]EPA National Water Quality Criteria for Surface Waters the protection of aquatic life in freshwater and marine water, Section 304(a) of the Clean Water Act, 2009.
[7]EPA Action Memorandum, Responsiveness Summary and Future Actions, Jorgensen Forge Early Action Area, October 2011.
[8]Screening level shown is for Chromium (III).
[9]Screening level shown is for Chromium (VI).
[10]Sample will be sent from ARI to Brooks Rand Laboratory for analysis.
[11]These RvALs were established based on SQS values, which are presented in units of mg/kg OC. The OC-normalized units were converted to mg/kg dw using a TOC concentration of 1.55%, reflecting the average TOC concentration in the T-117 Sediment Study Area based on both surface and subsurface sample results. For outside the range of acceptability for TOC normalization (0.5 to 4.0%), then the LAET (upon which the SQS is based) in dry-weight units of 0.13 mg/kg can be applied as a surrogate value.
[12]PCB data are normalized for total organic carbon content by dividing the sample concentration in mg/kg by the percent fraction of total organic carbon content of the sediment sample.
[13]Boeing Plant 2 TMCL values are less than the laboratory practical detection limit, therefore, the practical detection limit is used as the screening level.

µg/l = micrograms per liter
AWQC = ambient water quality criteria
CCC = criteria continuous concentration
CLARC = Cleanup Levels and Risk Calculations
CMC = criteria maximum concentration
Ecology = Washington State Department of Ecology
EPA = U.S. Environmental Protection Agency
ICP-MS = inductively coupled plasma mass spectrometry
LDW = Lower Duwamish Waterway
LOQ = Limits of Quantitation
mg/kg = milligrams per kilogram
NE = not established
NPDES = National Pollutant Discharge Elimination System
OC = organic carbon normalized
RvAL = removal action level
TMCL = target media cleanup level
TSC = Toxic Substances Criteria
WQC = water quality criteria

APPENDIX A
HEALTH AND SAFETY PLAN

ADDENDUM NO. 1 TO THE OPERATIONS, MONITORING, AND MAINTENANCE PLAN, BASIS OF DESIGN REPORT
Jorgensen Forge Early Action Area Removal Action
U.S. Environmental Protection Agency Docket No. CERCLA-10-2013-0032
Seattle, Washington

Farallon PN: 831-032

Washington
Issaquah | Bellingham | Seattle
Oregon
Portland | Bend
California
Oakland | Sacramento | Irvine

HEALTH AND SAFETY PLAN

ADDENDUM NO. 1 TO THE OPERATIONS, MONITORING, AND MAINTENANCE PLAN, BASIS OF DESIGN REPORT JORGENSEN FORGE EARLY ACTION AREA REMOVAL ACTION 8531 EAST MARGINAL WAY SOUTH TUKWILA, WASHINGTON

Submitted by:
Farallon Consulting, L.L.C.
975 5th Avenue Northwest
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Farallon PN: 831-032

For:
U.S. Environmental Protection Agency – Region 10
1200 Sixth Avenue
Seattle, Washington 98101

May 22, 2015

HEALTH AND SAFETY PLAN
REVIEW AND APPROVAL

Client: U.S. Environmental Protection Agency **Facility Name**: Earle M. Jorgensen
Project Name: Groundwater and Stormwater Monitoring **Project Number**: 831-032
Start Date: May 2015 **End Date**: May 2017

Plan Expiration Date: November 2017 (*Last day of expected fieldwork or no longer than 6 months*)

APPROVED BY:

Emerald Erickson-Mulanax Project Manager	Emerald Erickson-Mulanax ***Signature***	May 22, 2015 ***Date***
Gerald J. Portele Office Health and Safety Coordinator	***Signature***	May 22, 2015 ***Date***
Anna Sigel Site Health and Safety Officer	***Signature***	May 22, 2015 ***Date***
Amy Essig Desair Principal-in-Charge	Amy Essig Desair ***Signature***	May 22, 2015 ***Date***

This Health and Safety Plan (HASP) was written for the use of Farallon Consulting, L.L.C. (Farallon) and its employees. It may be used also by trained and experienced Farallon subcontractors as a guidance document. However, Farallon does not guarantee the health or safety of any person entering this Site.

Due to the potentially hazardous nature of the site and the activities occurring thereon, it is not possible to discover, evaluate, or provide protection for all possible hazards that may be encountered. Strict adherence to the health and safety guidelines set forth herein will reduce, but does not eliminate, the potential for injury. The health and safety guidelines in this HASP were prepared specifically for this site, its conditions, purposes, dates of field work, and personnel, and must be amended if conditions change.

Farallon claims no responsibility for the use of this HASP by others. This HASP will provide useful information to subcontractors and will assist them in developing their own HASP, but it should not be construed as a substitute for their own HASP. Subcontractors should sign this HASP (see *Health and Safety Plan Acknowledgment and Agreement Form*, Attachment 1) as an acknowledgement of hazard information and as notice that this HASP does not satisfy their requirement to develop their own HASP.

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ATTACHMENTS

Attachment 1	Health and Safety Plan Acknowledgement and Agreement Form
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Attachment 4	Daily Health and Safety Briefing Log
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Attachment 6	Near Miss Report Form
Attachment 7	Utility Clearance Logs
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1.0 SCOPE OF WORK

This Health and Safety Plan (HASP) was prepared for the use of Farallon Consulting, L.L.C. (Farallon) personnel while performing the following tasks in accordance with the Operations, Maintenance, and Monitoring Plan (OMMP) Addendum dated May 22, 2015:

- Groundwater Monitoring; and
- Stormwater Monitoring.

The tasks will be conducted in a manner consistent with the methods and assumptions outlined in the OMMP Addendum referenced above.

2.0 BACKGROUND INFORMATION

See the Removal Action Work Plan, Jorgensen Forge Early Action Area dated May 2014, prepared for the U.S. Environmental Protection Agency (EPA) by Anchor QEA, LLC and Pacific Pile & Marine, L.P.

3.0 DRUG AND ALCOHOL POLICY

It is Farallon's policy to maintain a drug-free workplace. Farallon has a responsibility to all of its staff members to provide a safe and inoffensive work environment, and a responsibility to its clients to provide accurate and consistent service. For these reasons, Farallon prohibits the following behavior by staff members in the field:

- Use of tobacco in any form by any person at any time in sensitive or hazardous areas that may pose a health and safety or environmental risk. The Site Health and Safety Officer (SHSO) may designate an area away from hazards that is safe for tobacco use;
- Possession or consumption of alcohol, or being under the influence of alcohol during field activities;
- Abuse of prescription and/or over-the-counter drugs in such a manner as to negatively impact performance or field safety; and
- Possession, use, sale, or being under the influence of illicit drugs while in the field or during any work hours.

Violation of any of the above codes of conduct is grounds for immediate removal from the project site and discipline in accordance with Farallon company policy. If an incident occurs as a result of an employee's actions, drug and alcohol testing will be performed in accordance with Farallon company policy.

4.0 WEAPONS POLICY

Farallon employees, contractors, subcontractors, and their employees working at the site are to ensure that they do not bring weapons onto the work site. Weapons include but are not limited to guns, knives, and explosives. Tools that are used during the course of field events, including but not limited to box knives, are exempt from this weapons policy. All vehicles and persons can be subjected to search while working at the property.

Failure to comply with the weapons policy can result in disciplinary action for the individual(s) involved in accordance with Farallon company policy.

5.0 INCIDENT PREPAREDNESS AND RESPONSE

Farallon employees and subcontractors working on site must be prepared to respond appropriately to an incident involving injury, illness, death, spills, or utility breaches. This section outlines the degree of preparedness required for employees at a work site, and describes the actions to be taken in the event of a health and safety incident.

5.1 HEALTH AND SAFETY PREPAREDNESS

All individuals working at the site are required to be familiar with the contents of this HASP. Additionally, the items on the following health and safety preparedness list should be reviewed prior to the commencement of work and during daily health and safety meetings:

- The directions to the hospital (provided in Attachment 2);
- The locations of first aid kits, personal eye washes, and fire extinguishers (located in site vehicles);
- The locations of the keys to site vehicles; and
- Hand sign language providing for the immediate stoppage of work (such as a horizontal hand movement in front of the neck).

Additional topics for daily health and safety meetings are included in Attachment 3, Potential Topics for Daily Health and Safety Meeting. Participation in daily health and safety meetings should be documented in the Daily Health and Safety Briefing Log (Attachment 4).

5.2 INJURY OR ILLNESS

If an injury or illness occurs, the following actions should be taken, regardless of the severity of the injury or illness:

- Stop work.
- Determine whether emergency response staff (e.g., fire, ambulance) are necessary. If so, dial 911 on a cell phone or the closest available telephone. Describe the location of the injured person and provide other details as requested. If an individual requires non-emergency medical care at a hospital, follow the directions to the nearest hospital, which are provided in Attachment 2. IF EMERGENCY MEDICAL CARE IS NEEDED CALL 911.
- Administer first aid to the individual immediately, using the first aid kit provided in the site vehicle. Use the bloodborne pathogens kit and personal eyewash, as needed.
- Notify the SHSO immediately. The SHSO is responsible for preparing and submitting an Incident Report form to Farallon's Health and Safety Coordinator (HSC) within 24 hours of the incident, and for notifying the employee's supervisor and the Principal in Charge. The Incident Report form is provided in Attachment 5.

- ***All incidents must be reported to the HSC within 24 hours; however, the actual investigation need not be completed within 24 hours.* A telephone message that includes the date, time, and general incident circumstances should be left at one of the following numbers if the HSC cannot be reached directly:**
  - HSC work phone: (425) 295-0800
  - HSC cell phone: (425) 466-1032
  - If the HSC cannot be located contact the Principal-in-Charge.

- The SHSO will assume responsibility during a medical emergency until emergency response personnel arrive at the site.

5.3 REPORTING PROCEDURES FOR MINOR CUTS, SCRATCHES, BRUISES, ETC.

Every occupational illness or injury is to be reported immediately by the employee to the SHSO. The SHSO is to complete the Incident Report form provided in Attachment 5, and report the incident to the HSC.

5.4 NEAR MISSES

A near miss is defined as an incident in which no personal injury is sustained and no property damage is incurred, but where injury and/or property damage could have occurred under slightly different timing or location.

In the event of a near miss, the following actions are to be taken:

- Stop work.
- Report the near miss to an SHSO immediately.
- The SHSO is to report the near miss to the HSC and complete the Near Miss Report form in Attachment 6.
- Resume work upon satisfactory resolution of the near-miss condition and documentation of the corrective action(s) taken by the SHSO.

5.5 MEDICAL INCIDENTS NOT REQUIRING AMBULANCE SERVICE

Medical incidents not requiring ambulance services include injuries and conditions such as minor lacerations, and sprains. In the event of an injury, an illness, or a condition that does not require ambulance service, the following actions are to be taken:

- Stop work.
- Administer first aid as necessary to stabilize the individual for transport to the hospital.

- The SHSO is to facilitate prompt transportation of the individual to the hospital. Directions to the nearest hospital are provided in Attachment 2.
- A representative of Farallon or the subcontractor is to drive the individual to the medical facility and remain at the facility until the individual is able to return to the jobsite, or arrangements for further care have been established.
- If the driver is not familiar with the route to the hospital, a second person who is familiar with the route is to accompany the driver and the injured employee to the hospital.
- If it is necessary for the SHSO to accompany the injured employee to a medical facility, provisions must be made for another employee who is trained and certified in first aid to act as the temporary SHSO before work at the jobsite can resume.
- If the injured employee is able to return to the jobsite the same day, he/she is to bring a statement from the doctor that provides the following information:
  - Date of incident
  - Employee's name
  - Diagnosis
  - Date he/she is able to return to work, and whether regular or light duty
  - Date he/she is to return to the doctor for a follow-up appointment, if necessary
  - Signature and address of doctor
- The SHSO is to complete the Incident Report form provided in Attachment 5, and report the incident to the HSC.
- If the injured employee is unable to return to the jobsite the same day, the employee who transported him/her should bring the statement from the doctor back to the jobsite. The information on this statement should be reported to the HSC immediately.

5.6 EMERGENCY CASES REQUIRING AMBULANCE SERVICE

In the event of an injury or illness that requires emergency response and transport to a hospital by ambulance the following actions should be taken:

- **Dial 911** to request ambulance service.
- Notify the SHSO.
- Administer first aid until the ambulance service arrives.
- One designated company representative should accompany the injured employee to the medical facility and remain there until final diagnosis, treatment plan, and other relevant information has been obtained.
- The SHSO is to complete the Incident Report form provided in Attachment 5, and report the incident to the HSC immediately.

5.7 EMPLOYEE DEATH, OR HOSPITALIZATION OF THREE OR MORE EMPLOYEES

The procedures outlined in Section 6.2 should be followed in the event of an employee injury or illness. If an employee fatality occurs, the HSC, local emergency personnel and the coroner must be notified **immediately**. **The HSC will initiate the required State of Washington Department of Labor and Industries and Occupational Safety and Health Administration (OSHA) notifications within 8 hours of a fatality or the hospitalization of three or more employees.**

5.8 RESPONSE TO SPILLS OR UTILITY BREACHES

The location of underground utilities (e.g., product, sewer, telephone, fiber optic) and facilities (e.g., USTs, septic tanks, utility vaults) is to be noted prior to commencement of intrusive subsurface work activities. Use the public and private locate services as required and complete the Utility Clearance Log (Attachment 7). If a utility line or tank is breached or a spill or release occurs, the event is to be documented on the Incident Report form provided in Attachment 5 as soon as possible. The date, time, name of the person(s) involved, actions taken, and discussions with other affected parties are to be included. The SHSO, Project Manager (PM) and client are to be notified immediately. The PM is to notify the regulatory authority and/or utility company, as necessary.

In the event of a spill or release, the following actions should be taken:

1. Stay upwind of the spill or release.
2. Don appropriate personal protective equipment (PPE).
3. Turn off equipment and other sources of ignition.
4. Turn off pumps and shut valves to stop the flow or leak.
5. Plug the leak or collect drippings, when possible.
6. Use sorbent pads to collect the product and impede its flow, if possible.
7. Dial 911 or telephone the local fire department immediately if a fire or another emergency situation develops.
8. Inform the Farallon PM of the situation.
9. Determine whether the client would like Farallon to repair the damage or would rather use an emergency repair contractor.
10. Advise the client of spill discharge notification requirements, and establish who will complete and submit the required forms. ***Do not report or submit information to an agency without the client's consent.*** Document each interaction with the client and regulators, and note in writing names, titles, authorizations, refusals, decisions, and commitments to any action.

11. Do not transport or approve transportation of contaminated soils or product until proper manifests have been completed and approved. Be aware that soil and/or product may meet criteria for hazardous waste.
12. Do not sign manifests as a generator of wastes. Contact the PM to discuss waste transportation.

5.9 NOTIFICATIONS

A spill or release requires completion of an Incident Report form (provided in Attachment 5) per Farallon's Health and Safety program. **The PM must involve the client and/or generator in the incident reporting process. The client and/or generator is under obligation to report the incident to the appropriate government agency(ies). If the spill extends into waterways, the Coast Guard and the National Response Center must be notified immediately by the client or with his permission (800 424-8802).**

5.10 SHUTOFF VALVES AND/OR SWITCHES FOR UTILITIES AND PRODUCTS

Before starting work locate and list below the location of utility and product line shutoff valves and switches on the project site. Review the location of shutoff valves and switches with field personnel before beginning work.

The shutoff valves and/or switches for electrical, natural gas, gasoline, water lines, etc.:

Will be completed in the field before starting work.

6.0 EMERGENCY RESPONSE AND EVACUATION PLAN

Farallon personnel and subcontractors working on site are to be aware of site-specific emergency and evacuation procedures, including alarm systems and evacuation plans and routes. If an incident occurs that requires emergency response, such as a fire or spill, **CALL 911 and request assistance**. Farallon staff, subcontractors, and/or others working in an area where an emergency occurs are to evacuate to a safe location away from the incident area, preferably upwind, and take attendance.

For this project the emergency evacuation gathering location is on the east side of the facility along East Marginal Way South.

If the emergency causes the route to be obstructed, Farallon personnel and subcontractors are to move to an open area upwind of the hazard area, and remain there until instructed by emergency response personnel (e.g., police, fire, ambulance personnel, paramedics) to do otherwise.

Subcontractors have the responsibility to account for their own employees and provide requested information to emergency response personnel immediately upon request. Farallon staff, subcontractors, and/or contractors may not reenter the scene of the emergency without specific approval from emergency response personnel.

7.0 LOCAL EMERGENCY CONTACT NAMES AND TELEPHONE NUMBERS

Local emergency response personnel can be contacted at the following numbers. Directions and a map to the hospital are included in Attachment 2.

Emergency Contact	Name and Location	Telephone No.
Hospital	Harborview Medical Center 325 9th Avenue Seattle, Washington 98104	(206) 744-3000
Police	City of Tukwila Police Department 6200 Southcenter Boulevard Tukwila, Washington 98188	**911** or (206) 433-1808
Fire	City of Tukwila Fire Department 444 Andover Park East Tukwila, Washington 98188	**911** or (206) 575-4404
National Response Center		**1-800-424-8802**
Washington State Department of Ecology		**(360) 407-6300**
Poison Control		**1-800-424-5555**

8.0 PROJECT PERSONNEL AND RELEVANT INFORMATION

Questions about this project that are posed by neighbors, the press, or other interested parties should be directed to the Principal in Charge at Farallon: (425) 295-0800.

Title Name Contact Information	General Project Responsibilities	Field Personnel Training Dates			Medical Surveillance Date
		40-Hour HAZWOPER	8-Hour Refresher	CPR/ First Aid	
Site Health and Safety Officer Anna Sigel Office: (425) 295-0800 Cell: (425) 577-4588	Implement this HASP. Has authority to stop work. Perform air quality tasks. Take charge of all incidents. Review subcontractor's HASP.	10/13/2012	2/2/2015	10/16/2014	3/11/2015
Farallon Personnel Emerald Erickson-Mulanax Office: (425) 295-0825 Cell: (425) 466-2271	Be familiar with HASP requirements and the Farallon Accident Prevention Program and Hazardous Waste Operations Program	3/6/2009	2/2/2015	10/16/2014	NA
Subcontractor Project Manager Cascade Drilling, Inc. Office: (425) 527-9700	Oversee work of own staff. Ensure that their own HASP is site-specific.	NA	NA	NA	NA
Subcontractor Personnel TBD	Be familiar with HASP requirements	NA	NA	NA	NA
Principal-in-Charge Amy Essig Desai Office: (425) 295-0800 Cell: (425) 241-1540	Provide immediate support upon notice of any incident.	NA	NA	NA	NA
Health and Safety Coordinator Richard McManus Office: (425) 295-0800 Cell: (425) 466-1032	Provide support in implementing HASP. Provide immediate support upon notice of any incident.	NA	NA	NA	NA
Client Contact Rebecca Chu Office: (206) 553-1774	Provide known analytical data from work performed by others. Provide notice of site hazards. Provide access to site. Provide information regarding available emergency supplies at the site.	NA	NA	NA	NA

9.0 POTENTIAL AIRBORNE CONTAMINANTS

The potential airborne contaminants of concern in the immediate vicinity at the site are listed in the table on the following page. The table should be reviewed, and any questions directed to the SHSO.

POTENTIAL AIRBORNE CHEMICALS ON SITE FOR THIS PROJECT REVIEW THIS TABLE AND CONTACT THE SHSO WITH ANY QUESTION						
Chemical (or Class)	**OSHA PEL ACGIH TLV**	**Other Pertinent Limits**	**Properties**	**Routes of Exposure or Irritation**	**Acute Health Effects**	**Chronic Health Effects/ Target Organs**
Arsenic	PEL 0.01 mg/m^3	Level for Respirator Use 0.005 mg/m^3; Level of Work Stoppage ½ IDLH – 2.5 mg/m^3	Gray, odorless solid.	Inhalation; dermal; ingestion. Inhalation and ingestion are a significant mode of exposure.	Irritated eyes, skin, and nose, cough, dizziness, nausea	Liver, kidney, gastrointestinal damage skin, lungs; potential carcinogen
Cadmium	PEL 0. 05 mg/m^3	Level for Respirator Use 0.025 mg/m^3; Level of Work Stoppage ½ IDLH – 12 mg/m^3	Soft bluish-silver lustrous metal, odorless solid.	Inhalation; skin absorption; ingestion; eye contact	Irritation to eyes, skin; headache; lassitude (weakness, exhaustion); central nervous system depressant; depression; poor equilibrium; dermatitis	Respiratory system, kidney, prostatic and lung cancer.
Chromium	PEL 1.0 mg/m^3	NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.	Solid, odorless, silver-gray solid.	Inhalation; dermal; ingestion. Inhalation and ingestion are a significant mode of exposure.	Irritation to eyes, skin, digestive tract; may cause headache, flu-like symptoms with metallic taste, fever, chills, cough, weekness, chest pain, and shortness of breath.	Liver, kidney, lungs are all target organs. Prolonged inhalation may cause respiratory tract inflammation and lung damage.

POTENTIAL AIRBORNE CHEMICALS ON SITE FOR THIS PROJECT REVIEW THIS TABLE AND CONTACT THE SHSO WITH ANY QUESTION						
Chemical (or Class)	**OSHA PEL ACGIH TLV**	**Other Pertinent Limits**	**Properties**	**Routes of Exposure or Irritation**	**Acute Health Effects**	**Chronic Health Effects/ Target Organs**
Copper	PEL 1.0 mg/m^3	Level for Respirator Use 0.5 mg/m^3; Level of Work Stoppage ½ IDLH – 50 mg/m^3	Filter/Sample Pump	Inhalation; skin absorption; ingestion; eye contact	Irritation to eyes, nose; central nervous system depressant; depression; dermatitis	Liver, kidney damage; potential occupational liver carcinogen. **Target Organs:** eyes, respiratory system, central nervous system, liver, kidneys
Lead	PEL - 0.05 mg/m^3 TLV - 0.05 mg/m^3	IDLH - 100 mg/m^3	A heavy, flexible, soft, gray solid.	Inhalation; dermal; ingestion; eye contact	Lassitude (weakness, exhaustion); abdominal pain; gingival lead line; tremor; irritation to eyes; hypotension	Insomnia; facial pallor; anorexia; weight loss; malnutrition; constipation; colic; anemia; paralysis: wrist, ankles; encephalopathy; kidney disease; potential for damage to eyes, gastrointestinal tract, CNS, kidneys, blood, gingival tissue
Mercury	PEL 0.1 to 0.01 mg/m^3	Level for Respirator Use 0.005 mg/m^3; Level of Work Stoppage ½ IDLH – 1 to 5 mg/m^3	Filter/Sample Pump	Eye irritant, skin, nose, throat, breath, swallow.	Eye irritant, skin burns, cough, chest pain, dyspnea, tremor, insomnia, indecision, head, weakness, GI disorder, progressive respiratory symptoms.	Central nervous system, eyes, throat, nose, skin, kidneys, bronpneuitis, stomatitis.

POTENTIAL AIRBORNE CHEMICALS ON SITE FOR THIS PROJECT REVIEW THIS TABLE AND CONTACT THE SHSO WITH ANY QUESTION						
Chemical (or Class)	**OSHA PEL ACGIH TLV**	**Other Pertinent Limits**	**Properties**	**Routes of Exposure or Irritation**	**Acute Health Effects**	**Chronic Health Effects/ Target Organs**
Polychlorinated biphenyls (PCBs)	PEL 0.5 - 1 mg/m^3 TLV 0.5 - 1 mg/m^3, depending on the species	NIOSH REL - 0.001 mg/m^3 NIOSH considers this material to be a carcinogen IDLH - 5 mg/m^3	Pale or dark yellow odorless liquid	Inhalation; dermal; ingestion. Skin absorption is a significant mode of exposure.	Irritation to eyes, skin, respiratory tract; chloroacne	May cause reproductive, CNS, CVS, skin, eye or liver effects, cancer (leukemia)
Silver	PEL 0.01 mg/m^3 TLV – 0.1 mg/m^3	NIOSH REL – 0.01 mg/m^3 NIOSH IDLH – 10 mg/m^3	Metallic powder or solid.	Absorbed through skin. Eye contact. Inhalation. Ingestion. Inhalation and ingestion are a significant mode of exposure.	Irritation to eyes, skin, may cause skin discoloration, may cause digestive and respiratory tract irritation.	Very hazardous in case of ingestion, of inhalation. Target organ: kidney.
Total Dust	Not Applicable	Level for Respirator Use 25 mg/m^3 as total dust and 15 mg/m^3 as respirable dust; Level of Work Stoppage ½ IDLH – Not Available	NA	Eye irritant, skin, nose, throat, conjuntivitus	Dyspnea (breathing difficulty), cough, copious sputum, chest pain, fever, cyanosis.	Cardiovascular system, respiratory system, eyes, throat, nose, skin. Pulmonary edema.
Zinc (as dust)	PEL 10 mg/m^3	Level for Respirator Use 5 mg/m^3; Level of Work Stoppage ½ IDLH – Not Available	Light blue, odorless solid.	Eye irritant, skin, nose, throat, conjuntivitus,	Dyspnea (breathing difficulty), cough, copious sputum, chest pain, fever, cyanosis, tachypnea, skin burns.	Cardiovascular system, respiratory system, eyes, throat, nose, skin. Pulmonary edema, fibriousis, pulmonale,

NOTES:
ACGIH = American Conference of Governmental Industrial Hygienists
AIHA = American Industrial Hygiene Association
AIHA WEEL = AIHA-set workplace environmental exposure limits
C = ceiling limit
CNS = central nervous system
CVS = cardiovascular system
IDLH = immediately dangerous to life or health
mg/m^3 = milligrams per cubic meter
NIOSH = National Institute for Occupation Safety and Health
OSHA = Occupation Safety and Health Administration
PEL = permissible exposure limit
ppm = parts per million
RBC = red blood cells
REL = recommended exposure limit set by National Institute for Occupational Safety and Health (NIOSH)
Skin = skin absorption
STEL = short-term exposure limit
TLV = threshold limit value set by ACGIH
TWA = time-weighted average

10.0 POTENTIAL SITE HAZARDS AND APPROPRIATE PRECAUTIONS

Activities listed may be associated with work performed by others. The information contained in this section is for the use of Farallon personnel and not intended for use by others. The following tables list potential hazards and appropriate precautions associated with planned field work:

10.1 ENVIRONMENTAL DRILLING

Job Steps	Personal Protective Equipment (PPE)	Potential Hazards	Critical Actions
Clear drilling locations	Reflective vest, steel-toed and -shank shoes, hard hat, safety glasses with side shields, and work gloves.	Traffic hazards Overhead or underground installations Product releases Property damage Occupant inconvenience	• Refer to Utility Clearance Log (**Attachment 7**). • Coordinate with Site Manger (or designee) to minimize potential conflicts. • Review proposed locations against available construction drawings and known utilities, tanks, product lines, etc. • Mark out the proposed borehole locations. • Call underground utility locating service for public line location clearance and obtain a list of utilities being contacted. If necessary, coordinate private line locator for private property. • Develop a traffic control plan with the client and local agencies, as applicable, which may include use of cones, barrier tape, jersey barriers, etc.
Mobilize with equipment/supplies suitable for drilling	Reflective vest, steel-toed and -shank shoes, hard hat, safety glasses with side shields, and work gloves.	Vehicle accident Lifting hazards Delay or improper performance of work due to improper equipment on site	• Begin each work day with tailgate safety meeting. • Follow safe driving procedures. • Employ safe lifting procedures. • Verify that subcontractors are aware of their responsibilities for labor, equipment, and supplies. • Review permit conditions.
Visually clear proposed drilling locations	Reflective vest, steel-toed and -shank shoes, hard hat, safety glasses with side shields, and work gloves.	Underground or overhead installations	• Complete Utilities and Structures checklist on the Utility Clearance Log (provided in **Attachment 7**) and adjust drilling locations as necessary.

Job Steps	Personal Protective Equipment (PPE)	Potential Hazards	Critical Actions
Set up necessary traffic control	Reflective vest, steel-toed and -shank shoes, hard hat, safety glasses with side shields, and work gloves.	Struck by vehicle during placement Vehicle accident resulting from improper placement of traffic control equipment	• Use buddy system for implementing traffic control plan, such as setting out cones and tape to define the safety area.
Assist with set up of rig	Reflective vest, steel-toed and -shank shoes, hard hat, safety glasses with side shields, and work gloves.	Vehicle accident during rig movement Damage caused by rig while accessing set-up location Contact with overhead installations Soft terrain Unexpected rig movement	• All staff should know the location of the kill switch for the drilling rig. • Verify a clear pathway to the drilling location, and clearance for raising mast. • Provide hand signals and guidance to the driver, as needed, to place rig. • Visually inspect rig (fire extinguisher on board, no oil or other fluid leaks, cabling and associated equipment in good condition, pressurized hoses secured with whip-checks or adequate substitute, jacks in good condition). • Use wooden blocks under jacks to spread load, if necessary. Chock wheels.
Set up exclusion zone(s) and work stations (drilling and logging and/or sample collection)	Reflective vest, steel-toed and -shank shoes, hard hat, safety glasses with side shields, and work gloves.	Struck by vehicle during setup Slip or fall hazards	• Implement exclusion zone set-up. Set up work stations with clear walking paths to and from rig. Use safety tape and cone(s).

Job Steps	Personal Protective Equipment (PPE)	Potential Hazards	Critical Actions
Clear upper 5 feet of drilling location using post-hole digger or hand auger	Reflective vest, steel-toed and -shank shoes, hard hat, safety glasses with side shields, ear plugs or ear muffs, work gloves. Respirator with organic vapor cartridges, chemical-resistant gloves, chemical-resistant apron as required.	Back strain Exposure to chemical hazards Hitting an underground utility Repetitive motion	• Keep full-face respirator with organic vapor cartridges readily accessible. • Initiate air quality monitoring in accordance with the air monitoring protocol presented in **Attachment 8**. • Stand upwind to avoid exposure whenever possible. • Use the organic vapor monitor aggressively to track the airborne concentration of contaminants close to potential sources, such as the core when it is being raised from the hole, the core is opened, etc. • Evaluate any soil samples inside a resealable plastic bag at arm's length. DO NOT EVALUATE THE SAMPLE IN THE OPEN, IN ORDER TO AVOID UNNECESSARY EXPOSURE. • Use correct lifting techniques and tools. • Complete the Pre-Drilling section of the Borehole Clearance Review form.
Drilling	Reflective vest, steel-toed and -shank shoes, hard hat, safety glasses with side shields, ear plugs or ear muffs, work gloves. Respirator with organic vapor cartridges, chemical-resistant gloves, chemical-resistant apron as required.	Back strain Heat or cold Eye injury Noise Exposure to chemical hazards Breaching an underground utility Trip or fall Equipment failure	• Stand clear of operating equipment. • Use correct lifting techniques. Monitor air quality in accordance with the air monitoring protocol presented in **Attachment 8**. Monitor drilling progress. • Keep work area clear of tripping or slipping hazards. • Perform periodic visual inspections of drill rig.

Job Steps	Personal Protective Equipment (PPE)	Potential Hazards	Critical Actions
Collect samples in accordance with sampling plan	Reflective vest, steel-toed and -shank shoes, hard hat, safety glasses with side shields, ear plugs or ear muffs, work gloves. Respirator with organic vapor cartridges, chemical-resistant gloves, chemical-resistant apron as required.	Back strain Heat or cold Eye injury Noise Exposure to chemical hazards Breaching an underground utility Trip or fall Equipment failure	• Stand clear of operating equipment. • Use correct lifting techniques. Monitor air quality in accordance with the air monitoring protocol presented in **Attachment 8**. Monitor drilling progress. • Keep work area clear of tripping or slipping hazards. • Perform periodic visual inspections of drill rig.
Manage cuttings	Reflective vest, steel-toed and -shank shoes, hard hat, safety glasses with side shields, ear plugs or ear muffs, work gloves. Respirator with organic vapor cartridges, chemical-resistant gloves, chemical-resistant apron as required.	Back strain Heat or cold Eye injury Noise Exposure to chemical hazards Breaching an underground utility Trip or fall Equipment failure	• Stand clear of operating equipment. • Use correct lifting techniques. Monitor air quality in accordance with the air monitoring protocol presented in **Attachment 8**. Monitor drilling progress. • Keep work area clear of tripping or slipping hazards. • Perform periodic visual inspections of drill rig.

Job Steps	Personal Protective Equipment (PPE)	Potential Hazards	Critical Actions
Backfill borehole	Reflective vest, steel-toed and -shank shoes, hard hat, safety glasses with side shields, ear plugs or ear muffs, work gloves. Respirator with organic vapor cartridges, chemical-resistant gloves, chemical-resistant apron as required.	Back strain Trip hazards Eye injury from splashing or release of pressurized grout	• Mix grout to specification and completely fill the hole. • Use proper lifting techniques. • Keep work area clear of tripping hazards. • Verify presence of and/or authorization by required grouting inspectors.
Develop well	Reflective vest, steel-toed and -shank shoes, hard hat, safety glasses with side shields, ear plugs or ear muffs, work gloves. Respirator with organic vapor cartridges, chemical-resistant gloves, chemical-resistant apron as required.	Physical injury from mechanical failure, drill rig, or air compressor Trip hazards. Exposure to contaminants Electric shock	• Verify that equipment is in good working order and that pressurized hoses are whip-checked. • Keep full-face respirator with organic cartridges readily accessible. • Keep work area orderly. • Any generators must be equipped with GFCI circuit.
Gauge water levels and product thickness in wells, where applicable	Reflective vest, steel-toed and -shank shoes, hard hat, safety glasses with side shields, ear plugs or ear muffs, work gloves. Respirator with organic vapor cartridges, chemical-resistant gloves, chemical-resistant apron as required.	Back strain Inhalation or dermal exposure to chemical hazards Repetitive motion	• Have full-face respirator with organic cartridges readily accessible. • Conduct air quality monitoring in accordance with the protocol presented in **Attachment 8.** • Maintain a safe distance from the well head. • Bend at knees rather than at the waist.
Purge well(s) and collect purge water	Reflective vest, steel-toed and -shank shoes, hard hat, safety glasses with side shields, ear plugs or ear muffs, work gloves. Respirator with organic vapor cartridges, chemical-resistant gloves, chemical-resistant apron as required.	Back strain Inhalation or dermal exposure to chemical hazards Slip or fall Contaminated water spill	• Use proper lifting techniques. • Use PPE, and adhere to air monitoring guidelines as presented in **Attachment 8**. • Keep work area clear of tripping or slipping hazards. • Store purge water in appropriate containers.

Job Steps	**Personal Protective Equipment (PPE)**	**Potential Hazards**	**Critical Actions**
Collect groundwater samples in accordance with sampling plan	Reflective vest, steel-toed and -shank shoes, hard hat, safety glasses with side shields, ear plugs or ear muffs, work gloves. Respirator with organic vapor cartridges, chemical-resistant gloves, chemical-resistant apron as required.	Cross-contamination Back strain Inhalation or dermal exposure to chemical hazards Slip or fall Improper labeling or storage of samples Injury from broken sample bottle (cuts or acid burns)	• Decontaminate sampling equipment between each well (unless disposable). • Use proper lifting techniques. • Have full-face respirator with organic cartridges within 3-5 feet of working location, and readily accessible. • Label samples in accordance with sampling plan. • Keep samples stored in appropriate containers, at correct temperature, and away from work area. Handle bottles carefully.
Dispose of or store any purge water on site	Reflective vest, steel-toed and -shank shoes, hard hat, safety glasses with side shields, ear plugs or ear muffs, work gloves. Respirator with organic vapor cartridges, chemical-resistant gloves, chemical-resistant apron as required.	Back strain Exposure to contaminants	• Use suitable equipment to transport water (e.g., pumps, drum dollies). • Have full-face respirator with organic cartridges within 3-5 feet of working location, and readily accessible. • Label storage containers properly, and locate in an isolated area away from traffic and other site functions. • Coordinate offsite disposal (where applicable).
Clean site; demobilize	Reflective vest, steel-toed and -shank shoes, hard hat, safety glasses with side shields, ear plugs or ear muffs, work gloves. Respirator with organic vapor cartridges, chemical-resistant gloves, chemical-resistant apron as required.	Traffic Lifting hazards	• Use buddy system to remove traffic control, as necessary. Leave site clear of refuse and debris. Clearly mark or barricade any borings that need topping off or curing at a later time. Notify site personnel of departure, final well locations, and any cuttings and/or purge water left onsite. Use proper lifting techniques.
Package and deliver samples to laboratory		Back strain Traffic accidents	• Handle and pack bottles carefully (e.g., bubble wrap bags). Use proper lifting techniques. • Apply safe driving practices.

Job Steps	Personal Protective Equipment (PPE)	Potential Hazards	Critical Actions
Typical work	Steel-toed and -shank shoes, hard hat, safety glasses with side shields, hearing protection, reflective safety vest, leather gloves for non-chemical aspects of work Chemical-resistant gloves and apron if chemical exposure is suspected.	Weather-related incidents: automobile accidents, slips or falls	• Check weather reports daily. Project visits are not to be performed during inclement weather. Sampling may be performed during light rain mist. Wear raincoats. • Drive at speed limit or less, as needed, to keep a safe distance from vehicle in front. Avoid short stops.
Typical work		Cold Stress	• For temperatures below 40°F, adequate insulating clothing must be worn. If the temperature is below 20°F, workers will be allowed to enter a heated shelter at regular intervals. Warm, sweet drinks should be available. Coffee intake should be limited. • No one should begin work or return to work from a heated shelter with wet clothes. Workers should be aware of signs of cold stress, such as heavy shivering, pain in fingers or toes, drowsiness, or irritability. Onset of any of these signs is an indication that immediate return to a heated shelter is needed. • Refer to ACGIH TLV Booklet for section on Cold Stress.
Typical work		Heat Stress	• Discuss health effects and symptoms during daily health and safety meetings. • Drink water regularly(at least one cup every 20-30 minutes, depending upon level of effort and the PPE worn). • Refer to ACGIH TLV booklet for heat stress guidance, especially regarding PPE, type of work and frequency of breaks. • Breaks should be taken in an area cooler than the work area. • Monitor temperature and relative humidity using WBGT meter.

Job Steps	**Personal Protective Equipment (PPE)**	**Potential Hazards**	**Critical Actions**
No eating, drinking, or smoking on site No contact lenses to be worn on site No facial hair that would interfere with respirator fit			
A safety meeting is to be held every day, even if only one person is working on the project on a given day.			• Topics are to always include the work scheduled for the day and restatement of hazards and the means to avoid them. Other topics may include sampling in general, and advances in technology and how they may be applied to the project. Use the *Daily Health and Safety Briefing Log* in **Attachment 4** to log the topics discussed.

10.2 MONITORING WELL SAMPLING/GAUGING

Job Steps	**Personal Protective Equipment**	**Potential Hazard**	**Critical Actions**
Mobilize with equipment/supplies suitable for sampling.	Reflective vest, steel-toed and -shank shoes, hard hat, safety glasses with side shields, ear plugs or ear muffs, work gloves.	Vehicle accident. Lifting hazards. Delay or unsafe performance of work due to lack of necessary equipment on site. Cross-contamination of wells.	Follow safe driving procedures. Use proper lifting techniques. Review work plan to determine equipment/supply needs. Verity that all sampling/gauging equipment has been decontaminated. Bring ice for sample storage. Review the HASP. Gather the necessary PPE.
Set up necessary traffic control.	Reflective vest, steel-toed and -shank shoes, hard hat, safety glasses with side shields, ear plugs or ear muffs, work gloves.	Struck by vehicle during placement. Vehicle accident as a result of improper traffic-control equipment placement.	Use buddy system for placing traffic control. Refer to the traffic control plan section of the HASP (which may include specific requirements based on encroachment permit).

Job Steps	Personal Protective Equipment	Potential Hazard	Critical Actions
Set up exclusion zone(s).	Reflective vest, steel-toed and -shank shoes, hard hat, safety glasses with side shields, ear plugs or ear muffs, work gloves.	Struck by vehicle. Slip or fall hazards to workers.	Face incoming traffic. Implement exclusion zone setup instructions of the HASP (e.g., barricades, caution tape, cones). Set up work area free of trip hazards.
Gauge water levels and product thickness (where applicable) in wells.	Reflective vest, steel-toed and -shank shoes, hard hat, safety glasses with side shields, ear plugs or ear muffs, work gloves. Respirator with organic vapor cartridges, chemical-resistant gloves, chemical-resistant apron as required.	Back strain. Inhalation of, or dermal exposure to, chemical hazards. Repetitive motion.	Wear required PPE. Initiate air quality monitoring in accordance with the HASP. Maintain a safe distance from wellhead. Bend at knees rather than at waist.
Purge well(s) and collect purge water.	Reflective vest, steel-toed and -shank shoes, hard hat, safety glasses with side shields, ear plugs or ear muffs, work gloves. Respirator with organic vapor cartridges, chemical-resistant gloves, chemical-resistant apron as required.	Cross-contamination. Back strain. Inhalation of, or dermal exposure to, chemical hazards. Slip or fall. Contaminated water spill.	Decontaminate purging equipment between each sampling location. Use proper lifting techniques. Use PPE and conduct monitoring in accordance with the HASP. Keep work area clear of tripping or slipping hazards. Store purge water in appropriate containers.
Collect samples in accordance with sampling plan.	Reflective vest, steel-toed and -shank shoes, hard hat, safety glasses with side shields, ear plugs or ear muffs, work gloves. Respirator with organic vapor cartridges, chemical-resistant gloves, chemical-resistant apron as required.	Cross-contamination. Back strain. Inhalation of, or dermal exposure to, chemical hazards. Slip or fall. Improper labeling or storage. Injury from broken sample bottle (e.g., cut, or acid burn).	Decontaminate sampling equipment between each well (unless disposable equipment). Use proper lifting techniques. Use PPE in accordance with the HASP. Label samples in accordance with sampling plan. Keep samples stored in suitable containers, at correct temperature, and away from work area. Handle bottles carefully.

Job Steps	Personal Protective Equipment	Potential Hazard	Critical Actions
Dispose of or store purge water on site.	Reflective vest, steel-toed and -shank shoes, hard hat, safety glasses with side shields, ear plugs or ear muffs, work gloves. Respirator with organic vapor cartridges, chemical-resistant gloves, chemical-resistant apron as required.	Back strain. Exposure to contaminants. Damage or injury from improper use of on-site treatment system equipment. Improper storage or disposal.	Use suitable equipment to transport water (e.g., pumps, drum dollies). Wear PPE in accordance with the HASP. Review any necessary instructions for use of on-site treatment systems. Label storage containers properly and locate in an isolated area away from traffic and other site functions. Coordinate off-site disposal, where applicable.
Clean site/demobilize	Reflective vest, steel-toed and -shank shoes, hard hat, safety glasses with side shields, ear plugs or ear muffs, work gloves.	Traffic. Safety hazard left on site. Lifting hazard.	Use buddy system to remove traffic control, as necessary. Leave site clear of refuse and debris. Notify business personnel of departure, and of any purge water left on site. Use proper lifting techniques.
Package and deliver samples to laboratory.		Bottle breakage. Back strain.	Handle and pack bottles carefully (e.g., bubble wrap bags). Use proper lifting techniques.

10.3 STORMWATER AND CATCH BASIN SOLIDS SAMPLING

Job Steps	Personal Protective Equipment	Potential Hazard	Critical Actions
Mobilize with proper equipment/supplies for inspection and drum sampling.	Safety glasses or goggles, hard hat, reflective safety vest, steel-toed boots, hearing protection, gloves. Chemical-resistant gloves and apron if chemical exposure is suspected.	Vehicle accident. Lifting hazards. Delay or improper performance of work due to improper equipment on site.	• Follow safe driving procedures. • Review HASP and gather necessary PPE.
Access stormwater sampling location.	Safety glasses or goggles, hard hat, reflective safety vest, steel-toed boots, hearing protection, gloves. Chemical-resistant gloves and apron if chemical exposure is suspected.	Struck by train/vehicle during access. Trip/slip/fall hazards.	• Contact on-site client contact to secure work area. • Ensure clear walking paths to all inspection and maintenance locations. • Mark and secure all work locations with caution tape, flagging, or cones if in the potential path of moving equipment or vehicles. • Face oncoming traffic. • Work in pairs if area is subject to equipment or vehicle traffic.
Collect samples.	Safety glasses or goggles, hard hat, reflective safety vest, steel-toed boots, hearing protection, gloves. Chemical-resistant gloves or apron if chemical exposure is suspected.	Exposure to site chemicals.	• Use chemical resistant gloves while collecting sample. • Avoid direct contact with media at all times.

11.0 WASTE CHARACTERISTICS

Waste anticipated to be generated on the project site:

Type(s): ☐ Liquid ☐ Solid ☐ Sludge ☐ Other________________

The approximate volume for each anticipated waste stream:

Waste: soil cuttings Approximate Volume: One, 55-gallons

Waste: purge/decon water Approximate Volume: Two, 55-gallons

Characteristics**:**

☐ Corrosive ☐ Flammable/Ignitable ☐ Radioactive ☐ Toxic

☐ Reactive ☐ Unknown ☐ Other *(specify)*____________________

12.0 TRAFFIC CONTROL

Work on this project site will be performed in areas of uncontrolled traffic access. Traffic control/warning devices will be placed around the work area to prevent undesirable interface between pedestrian and automotive traffic and project workers and equipment. These devices may include:

- Cones
- Tubular markers
- Barricades
- Temporary fencing
- Barricade tape

The traffic control/warning devices will be placed around the work in such a way that traffic access is inhibited (i.e. place cones less than 8 feet apart so cars cannot easily drive through work area without moving a cone). Barricade tape or temporary fencing will be used to inhibit access to the work area in locations where pedestrians will be encountered.

ATTACHMENT 1
HEALTH AND SAFETY PLAN ACKNOWLEDGEMENT AND AGREEMENT FORM

HEALTH AND SAFETY PLAN
Addendum No. 1 to the Operations, Monitoring, and Maintenance Plan, Basis of Design Report
Jorgensen Forge Early Action Area Removal Action
8531 East Marginal Way South
Tukwila, Washington

Farallon PN: 831-032

HEALTH AND SAFETY PLAN ACKNOWLEDGMENT AND AGREEMENT FORM

(All Farallon and subcontractor personnel must sign)

This Health and Safety Plan (HASP) has been developed for the purpose of informing Farallon employees of the hazards they are likely to encounter on the project site, and the precautions they should take to avoid those hazards. Subcontractors and other parties at the site must develop their own HASP to address the hazards faced by their own employees. Farallon will make a copy of this HASP available to subcontractors and other interested parties to fully disclose hazards we may be aware of, and to satisfy Farallon's responsibilities under the Occupational Safety and Health Administration (OSHA) Hazard Communication standard. Similarly, subcontractors and others on site are required to inform Farallon of any hazards they are aware of or that their work on site might possibly pose to Farallon employees, including but not limited to Material Safety Data Sheets for chemicals brought on site. This plan should NOT be understood by contractors to provide information pertaining to all of the hazards that a contractor's employees may be exposed to as a result of their work.

All parties conducting site activities are required to coordinate their activities and practices with the project Site Health and Safety Officer (SHSO). Your signature below affirms that you have read and understand the hazards discussed in this HASP, and that you understand that subcontractors and other parties working on site must develop their own HASP for their employees. Your signature also affirms that you understand that you could be prohibited by the SHSO or other Farallon personnel from working on this project for not complying with any aspect of this HASP.

Name	Title	Signature	Company	Date

ATTACHMENT 2
DIRECTIONS TO HOSPITAL

HEALTH AND SAFETY PLAN
Addendum No. 1 to the Operations, Monitoring, and Maintenance Plan, Basis of Design Report
Jorgensen Forge Early Action Area Removal Action
8531 East Marginal Way South
Tukwila, Washington
Farallon PN: 831-032

Driving directions

via Airport Way S — **17 min**

15 min without traffic · Show traffic — 6.1 miles

8531 East Marginal Way S

Tukwila, WA 98108

Take E Marginal Way S and Airport Way S to 6th Ave S in Seattle

11 min (5.3 mi)

Turn right onto 6th Ave S

Turn right onto Yesler Way

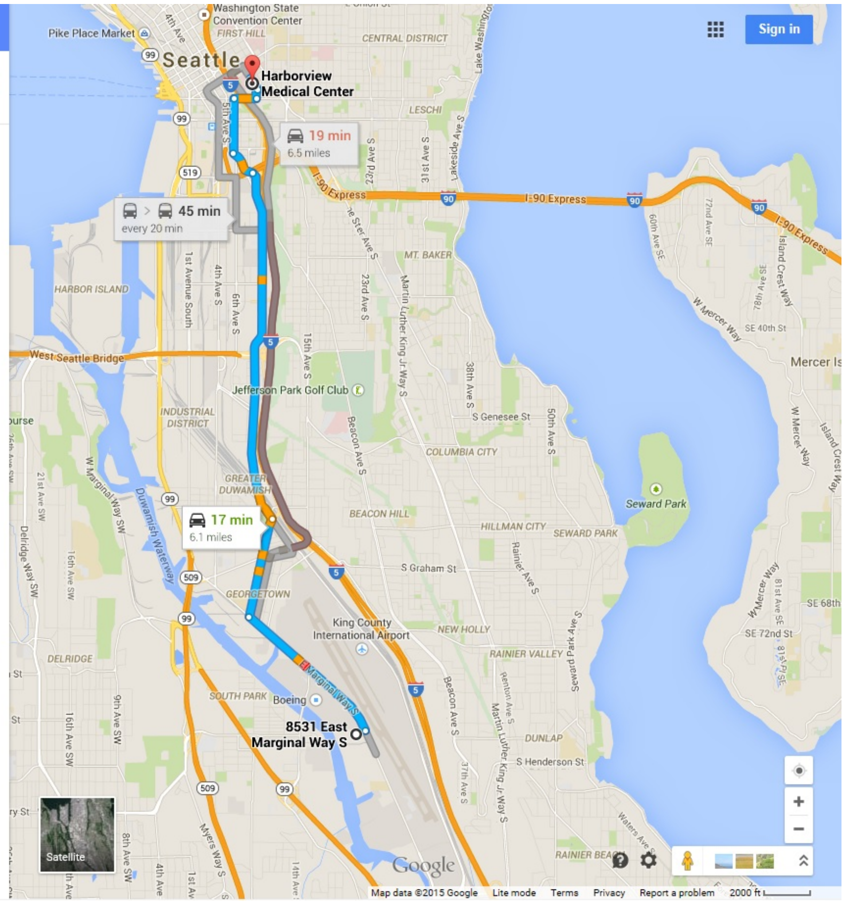
Drive to 9th Ave

47 s (0.2 mi)

Harborview Medical Center

325 9th Avenue, Seattle, WA 98104

These directions are for planning purposes only. You may find that construction projects, traffic, weather, or other events may cause conditions to differ from the map results, and you should plan your route accordingly. You must obey all signs or notices regarding your route.



ATTACHMENT 3
POTENTIAL TOPICS FOR DAILY HEALTH AND SAFETY MEETING

HEALTH AND SAFETY PLAN
Addendum No. 1 to the Operations, Monitoring, and Maintenance Plan, Basis of Design Report
Jorgensen Forge Early Action Area Removal Action
8531 East Marginal Way South
Tukwila, Washington
Farallon PN: 831-032

POTENTIAL TOPICS FOR DAILY
HEALTH AND SAFETY MEETING

- ☐ Emergency response plan, emergency vehicle (full of fuel) and muster point
- ☐ Route to medical aid (hospital or other facility)
- ☐ Work hours. Is night work planned?
- ☐ Hand signals around heavy equipment
- ☐ Traffic control
- ☐ Pertinent legislation and regulations
- ☐ Above- and below-ground utilities (energized or de-energized)
- ☐ Material Safety Data Sheets
- ☐ Reporting an incident: to whom, what, why, and when to report
- ☐ Fire extinguisher and first aid kit locations
- ☐ Excavations, trenching, sloping, and shoring
- ☐ Personal protective equipment and training
- ☐ Safety equipment and training
- ☐ Emergency telephone location(s) and telephone numbers (in addition to 911)
- ☐ Eye wash stations and washroom locations
- ☐ Energy lock-out/tag-out procedures. Location of "kill switches," etc.
- ☐ Weather restrictions
- ☐ Site security. Site hazards. Is special waste present?
- ☐ Traffic and people movement
- ☐ Working around machinery (both static and mobile)
- ☐ Sources of ignition, static electricity, etc.
- ☐ Stings, bites, large animals, and other nature-related injuries and conditions
- ☐ Working above grade
- ☐ Working at isolated sites
- ☐ Decontamination procedures (for both personnel and equipment)
- ☐ How to prevent falls, trips, sprains, and lifting injuries
- ☐ Right to refuse unsafe work
- ☐ Adjacent property issues (e.g., residence, business, school, daycare center)

ATTACHMENT 4
DAILY HEALTH AND SAFETY BRIEFING LOG

HEALTH AND SAFETY PLAN
Addendum No. 1 to the Operations, Monitoring, and Maintenance Plan, Basis of Design Report
Jorgensen Forge Early Action Area Removal Action
8531 East Marginal Way South
Tukwila, Washington
Farallon PN: 831-032

DAILY HEALTH AND SAFETY BRIEFING LOG

PROJECT INFORMATION	
Farallon PN:	Project Name:
Site Address:	City/State:
MEETING INFORMATION	
Conducted By:	Weather:
Major Job Task:	

HEALTH AND SAFETY DAILY CHECKLIST		
☐ Site Check In	☐ First Aid Kit	☐ Ear Plugs (if required)
☐ Proper Identification	☐ Fire Extinguisher	☐ Hand Protection (if required)
☐ Hard Hat	☐ Eye Wash Station	☐ Face Shield (if required)
☐ Safety Glasses	☐ Traffic Control	☐ Respirator (if required)
☐ Orange Reflective Vest (H or X back BNSF)		☐ ___________________________
☐ Safety Toe Boots (lace up and leather BNSF)		☐ ___________________________

HEALTH AND SAFETY BRIEFING	
Head Count	Excavation Safety (if applicable)
Emergency Response	Health Hazards
Who will call 911 (Name):	Environmental Hazards
Alternate to call 911 (Name):	Physical Hazards
First Aid/ CPR (Name):	Slips, Trips and Falls
Emergency Exits/ Rally Points/ Hospital Route	Utility Locates
Site Security	Near Miss Reporting (reminder to look)
Conducting Work Safely	Incident Reporting (Procedures and forms)
Stop Work Authority	Traffic Control
Vehicle/ Equipment Safety	

ADDITIONAL HEALTH AND SAFETY ISSUES DISCUSSED
1)
2)
3)
4)
5)

ATTENDEES		
NAME	**COMPANY**	**SIGNATURE**

ATTACHMENT 5
INCIDENT REPORT FORM

HEALTH AND SAFETY PLAN
Addendum No. 1 to the Operations, Monitoring, and Maintenance Plan, Basis of Design Report
Jorgensen Forge Early Action Area Removal Action
8531 East Marginal Way South
Tukwila, Washington
Farallon PN: 831-032

Accidental Injury, Occupational Illness, or Workplace Incident
INCIDENT REPORT

INCIDENT TYPE			INCIDENT DATE:
☐ FATALITY	☐ INDUSTRIAL NON-RECORDABLE	☐ SPILL/LEAK	☐ GENERAL LIABILITY
☐ LOST WORKDAY	☐ NON-INDUSTRIAL	☐ PRODUCT INTEGRITY	☐ CRIMINAL ACTIVITY
☐ LW RESTRICTED DUTY	☐ OFF-THE-JOB INJURY	☐ EQUIPMENT	☐ NOTICE OF VIOLATION
☐ OSHA MEDICAL OR ILLNESS W/O LW	☐ MVA	☐ BUSINESS INTERRUPTION	☐ OTHER
☐ FIRST AID	☐ FIRE	**(TO BE COMPLETED BY HEALTH AND SAFETY COORDINATOR)**	

This report must be completed by the employee or Health and Safety Coordinator immediately upon learning of the incident. The completed report must be reviewed and signed by a Principal, within 24 hours of the incident, even if employee is not available to review and sign. Employee or employee's doctor must submit a copy of the doctor's report to Jerry Portele within 24 hours of the initial exam and any subsequent exams. After hours or weekends, please call Rich McManus: Mobile (425) 466-1032 or Home (425) 557-9124.

EMPLOYEE INFO

LAST NAME:	FIRST NAME AND MIDDLE INITIAL:	TITLE:	TIME OF EVENT OR EXPOSURE: ☐ AM ☐ PM

EMPLOYMENT STATUS: ☐ FULL-TIME ☐ PART-TIME ☐ HOURLY-AS-NEEDED | HOW LONG?

DATE OF INJURY OR ONSET OF ILLNESS (MM/DD/YYYY)

INJURY OR ILLNESS INFO

EXACT LOCATION OF INCIDENT (ADDRESS, GEOGRAPHICAL LOCATION, FLOOR, BUILDING, ETC.):

COUNTY: | ON EMPLOYER'S PREMISES? ☐ YES ☐ NO

COMPLETE DESCRIPTION OF INCIDENT, INCLUDE SPECIFIC ACTIVITY DURING INCIDENT (LIFTING, PUSHING, WALKING, ETC.):

DESCRIBE THE EQUIPMENT, MATERIALS, OR CHEMICALS THAT DIRECTLY HARMED THE PARTY (E.G., THE MACHINE EMPLOYEE STRUCK AGAINST OR WHICH STRUCK EMPLOYEE; THE VAPOR INHALED OR MATERIAL SWALLOWED; WHAT THE EMPLOYEE WAS LIFTING, PULLING, ETC.):

DESCRIBE THE SPECIFIC INJURY OR ILLNESS (E.G., CUT, STRAIN, FRACTURE, SKIN RASH, ETC.):

BODY PART(S) AFFECTED (E.G., BACK, LEFT WRIST, RIGHT EYE, ETC.):

DATE EMPLOYER NOTIFIED: | TO WHOM REPORTED:

MEDICAL PROVIDER (HOSPITAL, DOCTOR, CLINIC, ETC.) INFO

NAME AND ADDRESS OF HEALTH CARE PROVIDER: | PHONE NO.:

TREATED IN EMERGENCY ROOM: ☐ YES ☐ NO | HOSPITALIZED OVERNIGHT AS INPATIENT: ☐ YES ☐ NO

Accidental Injury, Occupational Illness, or Workplace Incident
INCIDENT REPORT PAGE 2

INJURY/ILLNESS SEVERITY	TIME LOSS (Check all that apply)	WORKDAY PHASE
☐ NO TREATMENT REQUIRED ☐ FIRST AID ONLY ☐ MEDICAL TREATMENT ☐ FATALITY, ENTER DATE:	☐ RETURN TO WORK THE NEXT DAY ☐ NO TIME LOSS ☐ RESTRICTED ACTIVITY BEGIN DATE: RETURN DATE: ☐ LOST WORKDAY, NOT AT WORK BEGIN DATE: RETURN DATE:	☐ PERFORM NORMAL WORK DUTIES ☐ MEAL PERIOD ☐ REST PERIOD ☐ ENTERING/LEAVING ☐ CHRONIC EXPOSURE ☐ OTHER, SPECIFY:

MOTOR VEHICLE ACCIDENT (MVA)		PROFESSIONAL DRIVER?	☐ YES ☐ NO
TOTAL YEARS DRIVING:	COMPANY VEHICLE? ☐ YES ☐ NO	VEHICLE TYPE:	
NO. OF VEHICLES TOWED	NO. OF INJURIES:	NO. OF FATALITIES:	

THIRD PARTY INCIDENTS					
NAME OF OWNER		ADDRESS		PHONE NO.:	
DESCRIPTION OF DAMAGE: .					
ISSURANCE INFORMATION:					
WITNESS NAME		ADDRESS		PHONE NO.:	
WITNESS NAME		ADDRESS		PHONE NO.:	

REVIEWED BY			
NAME (PRINT)	SIGNATURE	TITLE	DATE

ADDITIONAL INFORMATION (USE SPACE BELOW FOR ADDITIONAL INFROMATION AS NECESSARY TO COMPLETE THIS FORM.)

ATTACHMENT 6
SAFETY OBSERVATION AND NEAR MISS REPORT FORM

HEALTH AND SAFETY PLAN
Addendum No. 1 to the Operations, Monitoring, and Maintenance Plan, Basis of Design Report
Jorgensen Forge Early Action Area Removal Action
8531 East Marginal Way South
Tukwila, Washington
Farallon PN: 831-032

SAFETY OBSERVATION AND NEAR MISS REPORT

This report is to be filled out by any employee involved in or witnessing a near miss, or making a safety observation. A near miss is an incident that did not result in any personal injury, property damage, or production interruption, but could have under slightly different circumstances. A safety observation is witnessing any activity that places a person or property at risk of injury, accident, or damage. These are very important indicators of potentially harmful future accidents, and provide valuable insights to preventing personal injury and/or property damage.

PROJECT INFORMATION	
Farallon PN:	Project Name:
Site Address:	City/State:
INCIDENT INFORMATION	
Date:	Time: ☐ AM ☐ PM
Exact Location:	
Description of Incident or Potential Hazard:	
Corrective Action Taken:	
Lessons Learned:	

Employee Signature ______________________________ Date: ____________________

Printed Name ________________________________

Supervisor Signature ______________________________ Date: ____________________

Printed Name ________________________________

ATTACHMENT 7
UTILITY CLEARANCE LOGS

HEALTH AND SAFETY PLAN
Addendum No. 1 to the Operations, Monitoring, and Maintenance Plan, Basis of Design Report
Jorgensen Forge Early Action Area Removal Action
8531 East Marginal Way South
Tukwila, Washington
Farallon PN: 831-032

UTILITY CLEARANCE LOG

Project Name: ______________________________ **Project Number:** ___________________

Location: __________________________________ **Date of Work:** ____________________

Instructions. This log must be completed by a Farallon staff member **before** any Farallon-directed excavation (e.g., test pit excavation) or drilling operation.

DRILLING OR EXCAVATION WORK MAY NOT COMMENCE
UNTIL UTILITY LOCATES HAVE BEEN COMPLETED
(See the One-Call Utility Locate Request Procedure on the following page)

Farallon is responsible for having underground utilities and structures located and marked when drilling or directing test pit excavation operations. Any drilling or excavation within 2 feet of a marked utility must be done with hand tools.

Owners of underground utilities are required by law to mark underground facilities on public and private property. Owners of underground utilities are **not required** to mark existing service laterals or appurtenances. Utility owners in Washington are required to subscribe to the One-Call service.

Private utility locate services must be hired to locate service laterals and other buried utilities (e.g., on-site electric distribution lines, irrigation pipes) on private property.

Re-mark after 10 days or maintain as appropriate.

Utility Locate Checklist

☐ Attach map showing drilling and/or excavation sites and known utilities

☐ Attach copy of One-Call Utility Notification Ticket (http://www.searchandstatus.com/)

One-Call Utility Notification Ticket Number: ________________________________

☐ Attach copy of Side Sewer Card (available for City of Seattle; check municipality for availability)

☐ Attach copy of Private Locate Receipt

☐ Photograph all excavation and/or drilling locations and download to project file

☐ Review utilities with Site Contact:

Name: __ Phone: ____________________

Utilities and Structures

Utility Type	Utility Name	Public Utilities Marked (Y/N)	Private Utilities/Laterals Marked (Y/N)	Marking Method (Flags, paint on pavement, wooden stakes, etc.)
Petroleum product lines				
Natural gas line				
Water line				
Sewer line				
Storm drain				
Telephone cable				
Electric power line				
Product tank				
Septic tank/drain field				
Other				

Farallon Consulting, L.L.C.

Field Team Leader: ______________________________ Date: ____________________

Electric = RED	*Gas-Oil-Steam =* YELLOW	*Comm-CATV =* ORANGE	*Water =* BLUE/PURPLE	*Sewer =* GREEN	*Temp Survey =* PINK

ONE-CALL UTILITY LOCATE REQUEST PROCEDURE

THE ONE-CALL UTILITY NOTIFICATION CENTER REQUIRES 48 HOURS NOTICE TO MARK UTILITIES BEFORE YOU CAN DIG OR DRILL

Washington: 1-800-424-5555
Oregon: 1-800-332-2344

Washington state law states that "before commencing **any** excavation," the excavator or driller must provide notice to all owners of underground utilities by use of the One-Call locator service, and that the excavator or driller shall not dig or drill until all known utilities are marked. To fully comply with the law, you **must** take the following steps:

1. **Call before you dig or drill:** Notify the One-Call Utility Notification Center (OCUNC) a minimum of 48 hours (two full business days) before digging or drilling. Provide the following **required** information:
   a. Your name and phone number, company name and mailing address, and Farallon Account Number 25999.
   b. The type of work being done.
   c. Who the work is being done for.
   d. The county and city where the work is being done.
   e. The address or street where the work is being done.
   f. Marking Instructions: "Generally locate entire site including rights-of-way and easements"

   Provide the following information if applicable or requested:
   a. The name and phone number of an alternate contact person.
   b. If the work is being done within 10 feet of any overhead power lines.
   c. The nearest cross street.
   d. The distance and direction of the work site from the intersection.
   e. Township, range, section, and quarter section of the work site.

2. **Record the utilities that will be notified:** OCUNC will tell you the utilities that are on or adjacent to the site, based on their database. Record the name(s) of the utility on the reverse side of this form.

3. **After the 48-hour waiting period, confirm that the utility locations have been marked:** Before digging or drilling, walk the site and confirm that the utility companies have marked the utility locations in the field.

4. **If a locate appears to be missing:** If a utility locate appears to be missing and the utility company has not notified you that there are no utilities in the area, call OCUNC and:

   a. Provide the OCUNC locate number.
   b. Clearly state which utility has not been marked. The call is being recorded.
   c. Ask for a contact person at that utility.
   d. Call the contact person for the missing utility locate: Determine why there is no utility locate in the field.
   e. Record the reason(s) for the missing locate(s): There are valid reasons that locates do not appear in the field (e.g., there are no utilities located on the site or the utility has been abandoned). However, IF THEY ARE LATE, **YOU MUST WAIT** TO DRILL OR DIG. If the utility fails to mark a locate within the required 48 hours (two full business days), the utility is liable for delay costs.

5. **Hand dig within 2 feet of a marked utility:** When digging or drilling within 2 feet of any marked utility, the utility must be exposed first by using hand tools.

Electric =	*Gas-Oil-Steam =*	*Comm-CATV =*	*Water =*	*Sewer =*	*Temp Survey =*
RED	**YELLOW**	**ORANGE**	**BLUE/PURPLE**	**GREEN**	**PINK**

6. **Record reason(s) for missing locate(s) –** There may be reasons that locates do not appear in the field (e.g., no utilities are located on the site, utility has been abandoned). Record the reason given. IF THEY ARE LATE – YOU WAIT TO DRILL OR DIG. If the utility failed to mark within the required two days they are liable for delay costs.
7. **Hand dig within two feet –** When digging or drilling within two feet of any marked utility the utility must be exposed first by using hand tools.

FARALLON CONSULTING, L.L.C.
975 5th Avenue Northwest
Issaquah, Washington
98027

TELEPHONE CONVERSATION
Date:____________________Time:__________
Project Name:____________________________
Job No:__________________________________
Phone No:1-800-424-5555 WA, 1-800-332-2344 OR
Prepared By/Initials: _____________________
Call: ☐ Placed ☐ Received

Contact/Title:____

Agency/Region: One-Call Utility Notification Center

PROJECT:____

1. Your name and the Farallon Account Number #25999____________________________

2. What is the type of work being conducted? (Environmental drilling, test pit excavation)

____

3. Who is the property owner? ____

4. County and city were work is being done?___________________________________

5. Address or street where work is taking place?_______________________________

____

6. Nearest cross street?____

7. Distance and direction of the worksite from the intersection?______________________

8. Marking Instructions (Generally locate on entire site including rights-of-way and easements):____

____

____

9. What time and date will the locate be completed?______________________________

10. Utility Locate Request Number?____

11. Utilities that will be notified?____

____

12. Any Overhead Concerns?____

____

cc:____Page____________of__________

Note: Bold indicates required information

ATTACHMENT 8
AIR MONITORING TABLE AND FORMS

HEALTH AND SAFETY PLAN
Addendum No. 1 to the Operations, Monitoring, and Maintenance Plan, Basis of Design Report
Jorgensen Forge Early Action Area Removal Action
8531 East Marginal Way South
Tukwila, Washington
Farallon PN: 831-032

ACTION LEVEL TABLE FOR AIR MONITORING

The Air Monitoring table (following page) presents protocol for monitoring ambient air for constituents of concern and other parameters that may affect worker safety. Please note the following with respect to use of this table:

- The Level for Respirator Use indicates the concentration at which a respirator must be donned. It does not require that the job stop. The respirator is a piece of equipment that is to be used while determining why a concentration has reached that level. Implement engineering controls such as water mist, spray foam, plastic cover, etc. to reduce the concentration.

- The Level for Work Stoppage indicates the concentration at which work on the job must stop. Determine why a concentration has reached that level, and how it can be decreased. Site evacuation is not necessary at this level. Stopping work does not imply that the concentration level will decrease. Implement engineering controls to reduce the concentration; resume work when it is safe to do so.

- These values can be modified under particular site conditions and with specific knowledge of the contaminant(s). Should such conditions arise, contact Farallon's Health and Safety Officer, Richard McManus at (425) 295-0800.

AIR MONITORING

Chemical (or Class)	Monitoring Equipment	Task	Monitoring Frequency and Location	Level for Respirator Use	Level for Work Stoppage
Volatile Organic Vapors	Flame ionization detector (FID)/ photoionization detector (PID) as appropriate for chemicals of concern. Read manual to determine. Draeger Tube for vinyl chloride (Model 1/a; Part Number 67 28031). Draeger Tube for benzene (Model 0.5/a).	From start of mobilization to completion and demobilization.	Sampling should be continuous during the project while disturbing potentially contaminated soil, uncovering and/or removing tanks and piping, or drilling —at least every 15 minutes in the breathing zone. Sample at the exclusion zone boundaries every 30 minutes. Continuously sample during each soil and groundwater sampling interval. If 10 parts per million (ppm) in breathing zone, collect a Draeger Tube for benzene and/or vinyl chloride (depending upon contaminants of concern).	20 ppm above background sustained in breathing zone for 2 minutes, and no benzene and/or vinyl chloride tube discoloration. If a color change appears on the tube for benzene or vinyl chloride at 10 ppm on FID/PID, don respirator. If no Draeger Tube is available, the level for respirator use is to be 5 ppm.	50 ppm above background in breathing zone and no vinyl chloride or benzene tube discoloration. Stop work if tube indicates > 1 ppm for benzene or vinyl chloride. If no Draeger Tube is available, stop work at 25 ppm.

AIR MONITORING EQUIPMENT CALIBRATION/CHECK LOG

Date	Instrument/ Model No.	Serial No.	Battery Check OK?	Zero Adjust OK?	Calibration Gas (ppm)	Reading (ppm)	Leak Check	Performed By	Comments

AIR MONITORING LOG

Date	Time	Location	Source/Area/ Breathing Zone	Instrument	Concentration/Units	Sampled by

APPENDIX B
STANDARD OPERATING PROCEDURES

ADDENDUM NO. 1 TO THE OPERATIONS, MONITORING, AND MAINTENANCE PLAN, BASIS OF DESIGN REPORT
Jorgensen Forge Early Action Area Removal Action
U.S. Environmental Protection Agency Docket No. CERCLA-10-2013-0032
Seattle, Washington

Farallon PN: 831-032

STANDARD OPERATING PROCEDURES

APPENDIX B OF ADDENDUM NO. 1 TO THE OPERATIONS, MONITORING, AND MAINTENANCE PLAN, BASIS OF DESIGN REPORT

JORGENSEN FORGE EARLY ACTION AREA REMOVAL ACTION SEATTLE, WASHINGTON

Submitted by:
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1.0 WELL CONSTRUCTION
SOP NO. FAR-102

1.1 PURPOSE

The purpose of this standard operating procedure (SOP) is to provide field personnel with a set of guidelines to ensure proper well construction and installation. The monitoring well construction is ultimately at the discretion of the Project Manager and is based on the geology and use of the well. Typically, monitoring wells for routine groundwater monitoring will be constructed using 2-inch-diameter Schedule 40 polyvinyl chloride well casing with 0.010-inch slotted screens due to the finer-grained materials that are prevalent in the Puget Sound Area. Slot sizes and sand sizes may be increased at the discretion of the Project Manager, depending on the local geology. All wells must be installed and decommissioned by a licensed well driller, and constructed in general accordance with Chapter 173-160 of the Washington Administrative Code, the Minimum Standards for Construction and Maintenance of Wells. For projects outside the state of Washington, wells will be installed in accordance with the standards for well construction established for that state, or project-specific required standards such as the *Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells* dated March 1991, prepared by the U.S. Environmental Protection Agency (EPA).

1.2 EQUIPMENT

The following equipment is necessary for the construction and installation of monitoring wells:

- Well-construction equipment (e.g., water-level meter, photoionization detector [PID], tape measure, digital camera, plastic sheeting), as applicable.
- Well-construction materials (e.g., well casing [screened and blank], filter pack sand, bentonite and/or Volclay Grout annular seal material, concrete, locking casing cap, wellhead flush-mounted or stove-pipe monument complete with locking top, bollards for placement around wellhead monument, if needed), as provided by the driller.
- Materials necessary to provide required documentation, including Log of Monitoring Well and Monitoring Well Construction Data and Field Report forms.
- Personal protective equipment (PPE) as described in the site-specific Health and Safety Plan.
- Decontamination equipment as specified in the EPA low flow sampling guidance EPA 1996.

1.3 DECONTAMINATION

Equipment that will come into contact with potentially contaminated soil and groundwater is to be decontaminated before arrival at the site, upon relocation at the site, and upon exit from the site.

1.4 PROCEDURES

The instructions listed below are to be followed for well construction and installation:

- Don appropriate PPE as described in the site-specific Health and Safety Plan.
- Call the Project Manager to discuss the geology and groundwater conditions at the Site prior to installation of the casing to confirm the depth at which the well screen should be placed and the length of screen to be used.
- Measure the depth to the bottom of the well borehole to calculate the appropriate placement and length of the screened interval, filter pack, annular seal, and concrete surface seal. Calculate approximate volumes of the filter pack and seal material required for the specific well bore annulus and well casing diameter. Ensure that the filter pack extends from the bottom of the well intake to approximately 2 to 5 feet above the top of the well intake, and is approximately 2 to 4 inches thick. The well casing should be centered in the borehole. Ensure that the annular seal is a minimum of 2 feet thick above the top of the filter pack, and that the concrete seal is a minimum of 2 feet in depth from the surface.
- For boreholes that were completed to depths deeper than the well casing, the borehole must be backfilled with bentonite, sand, or pea gravel. Measure and check the lengths of the well screen and the blank casing prior to installation, confirm the slot size and the sand filter pack size, confirm the type of bentonite seal and/or Volclay Grout seal, and the wellhead monument. Record the type and brand of the well construction materials used.
- Record the start and completion times for the various stages of well construction such as installation of the well casing into the borehole, filter pack and seal emplacement, and wellhead monument.
- Record the volumes of filter pack, bentonite seal, and concrete used to construct the well, and check against calculated volumes to confirm proper placement and amount. During the construction process, record irregularities that could indicate construction problems such as bridging of the filter pack or seal material.
- Upon completion of well installation, measure the total well depth and the depth to groundwater, and record the measurement on the Monitoring Well Construction Data form.

1.5 DOCUMENTATION

Document well construction activities on the Monitoring Well Construction Data form and the Field Report form.

1.6 REFERENCES

U.S. Environmental Protection Agency. 1991. *Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells.* EPA 600/4-89/034. March.

U.S. Environmental Protection Agency (EPA). 1996. *Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures*. EPA/540/5-95/504. April.

2.0 MONITORING WELL DEVELOPMENT
SOP NO. FAR-103

2.1 PURPOSE

The purpose of this SOP is to provide field personnel with a set of guidelines to ensure proper monitoring well development. All monitoring wells should be developed to: create an effective filter pack around the well screen; rectify damage to the formation caused by drilling; remove fine particulates from the formation near the borehole; and assist in restoring the natural water quality of the aquifer in the vicinity of the well.

2.2 APPLICATION

The step-by-step guidelines provided in this SOP are to be followed by the field crew performing or overseeing monitoring well development.

2.3 EQUIPMENT

The following equipment is necessary to properly develop a groundwater monitoring well:

- A well key, hand drill, socket set, padlock key, or other well-access equipment.
- An electric water-meter sufficiently long to reach the bottom of the well, calibrated to 0.01 foot.
- Well-purging equipment (e.g., silicone line, polyvinyl chloride pipe, plug, pump, tubing, power supply, extension cord), as applicable.
- A sufficient number of 55-gallon drums (including lids, gaskets, and fasteners) or a portable polyethylene tank of sufficient capacity to contain all purge water unless other water-handling arrangements have been made.
- Materials necessary to provide required documentation (e.g., sample labels, Field Report forms, Well Construction Data, and Chain of Custody forms).
- PPE as described in the site-specific Health and Safety Plan.
- Decontamination equipment.

2.4 DECONTAMINATION

Equipment that will come into contact with well water is to be decontaminated before arrival at the site, upon relocation at the site, and upon exit from the site.

2.5 PROCEDURES

The instructions below are to be followed for each well:

- Suit up in appropriate PPE as described in the site-specific Health and Safety Plan.
- Brush away soil and vegetation, and pump standing water away from the well opening.
- Open the well cap.
- Measure and record the depth to water and the total depth of the well using a decontaminated water-level indicator. Obtain measurements to the nearest 0.01 foot, and record on the Field Report form and the Well Construction data form.
- Compute the unit purge volume (in gallons) using the formula and the input values on the Well Volumes table below:

1 well volume (including annular space) =
[x(total well depth – water level)] + [y(total well depth – bottom of seal)]

Where "x" is the casing/riser volume per unit length, internal (gallons per linear foot), and "y" is the annular volume per unit length (gallons per linear foot)

Well Volumes

Hole Diameter (inches)	Casing Diameter (inches)	Volume$_{casing}$ (gallons/linear foot) (x)	Volume$_{annulus}$ (gallons/linear foot) (y)
7	2	0.17	0.68
8	2	0.17	0.98
10	4	0.65	1.34
12	4	0.65	2.07
12	6	1.47	1.70
14	8	2.61	1.98

2.5.1 Development Procedures—New Wells

The instructions below are to be followed for development of new monitoring wells:

- Attach one length of twine to the surge block (or use a drill rig or tripod) and lower it to the bottom of the well.
- Vigorously move the surge block up and down in the well to create a surging action across the screened interval, which will bring finer-grained material into suspension. Move the surge block up and down in 3- foot sections until the entire well screen length as been surged.
- Remove the surge block.

- If a submersible pump is to be used for well development, gently lower the pump to the well bottom. If a non-submersible pump is to be used, lower the tubing to the bottom of the well.
- Begin purging the well at a rate sufficient to remove fines, slowly running the pump up and down the well over the length of the screen.
- Remove a minimum of three and a maximum of five well volumes of water (including annular space). If this event is the first time the well has been developed and water was used in the drilling process, remove the volume of water introduced during well construction. Purging has been completed when *one* of the following has occurred:
    - The minimum purge volume has been removed; <u>OR</u>
    - The well runs dry; <u>OR</u>
    - Five purge volumes of water and the drilling process water volume have been removed.
- Measure the total depth of the well after development.
- Containerize the purge water in 55-gallon drums unless other handling arrangements have been made.
- Record additional information such as unique odor or water color noted, and a description of the suspended particle content in the field notes and on applicable field forms.
- Upon completion of well development, properly seal and secure the well and drums.
- Permanently label the drums as follows:
    - Boring/well ID
    - Facility name
    - Drum contents
    - Percent filled
    - Date
    - Drum number
- Close the well appropriately and record any well-integrity concerns in the field book and on the Well Construction Data form.

2.5.2 Redevelopment Procedures—Existing Wells

Existing wells in a monitoring network may require redevelopment if an excessive amount of fines are present in the well casing that could interfere with stabilization of water-quality parameters or collection of representative water-quality samples. The instructions below are to be followed for redevelopment of existing wells:

- Remove the pump and/or dedicated tubing from the well.
- Attach one length of twine to the surge block (or use a drill rig or tripod) and lower it to the bottom of the well.
- Vigorously move the surge block up and down in the well to create a surging action across the screened interval, which will bring finer-grained material into suspension. Move the surge block up and down in 3-foot sections until the entire well screen length has been surged.
- Remove the surge block.
- Begin purging the well at a sufficient rate to remove fines. Initiate physical water-quality testing for turbidity.
- Repeat surging and purging to reduce silt presence in the water. Continue checking total depth measurements.
- Remove a minimum of three and a maximum of five well volumes of water (including annular space). Purging has been completed when *one* of the following has occurred:
    - The minimum purge volume has been removed; <u>OR</u>
    - The well runs dry; <u>OR</u>
    - Five purge volumes of water and the drilling process water volume have been removed.
- Measure the total depth of the well after development.
- Containerize the purge water in 55-gallon drums unless other handling arrangements have been made.
- Record additional information such as unique odor or water color noted, and a description of the suspended particle content in the field notes and on applicable field forms.
- Upon completion of well development, properly seal and secure the well and drums.
- Permanently label the drums as follows:
    - Boring/well ID
    - Facility name
    - Drum contents
    - Percent filled

- Date
- Drum number

- Close the well appropriately and record any well-integrity concerns in the field book and on the Well Construction Data form.

2.6 DOCUMENTATION

Document monitoring well development activities on the Well Construction Data form and in the detailed field notebook.

3.0 GROUNDWATER SAMPLING PROCEDURES
SOP NO. FAR-105

3.1 PURPOSE

The purpose of this SOP is to provide groundwater sampling personnel with the information needed to collect and document groundwater samples from monitoring wells using EPA (1996) low-flow groundwater sampling procedures for chemical analysis to ensure consistent and representative sampling.

3.2 APPLICATION

The step-by-step guidelines provided in this SOP are to be followed by the field crew conducting groundwater sampling.

3.3 EQUIPMENT

The following equipment is necessary to properly purge and sample a groundwater monitoring well:

- A well key, hand drill, socket set, padlock key, bailer, or other well-access equipment.
- An electric water-meter sufficiently long to reach the bottom of the well, calibrated to 0.01 foot.
- Well-purging equipment (e.g., pump, tubing, power supply, extension cord).
- A sufficient number of 55-gallon drums, including lids, gaskets, and fasteners, to contain all purge water unless other water-handling arrangements have been made.
- A flow-through water-quality meter(s) to measure temperature, pH, specific conductivity, dissolved oxygen, redox potential, and turbidity.
- Materials necessary to provide required documentation, (e.g., sample labels, Field Report form, Low Flow Well Purging and Sampling Data Form, and Chain of Custody form).
- Sample containers with the chemical preservatives appropriate for the samples, as described in the project-specific Field Sampling Plan or required by the analytical laboratory.
- PPE as described in the site-specific Health and Safety Plan.
- Sampling support equipment (e.g., sample coolers, ice and/or blue ice, bubble wrap, clear tape, duct tape, resealable plastic bags, razor knives, garbage bags, paper towels, distilled water, nitrile gloves).

3.4 DECONTAMINATION

Reusable equipment that will come into contact with the well and/or be used to acquire samples is to be decontaminated before arrival at the site, upon relocation at the site, and upon exit from the site.

3.5 WELL SAMPLING PROCEDURES

Well sampling procedures have been developed for monitoring wells with a dedicated pump (dedicated wells) and for monitoring wells without a dedicated pump (non-dedicated wells). The sections below present the procedures for setup, purging, sample collection, and post-sampling activities for dedicated and non-dedicated wells.

3.5.1 Setup

Setup procedures differ slightly for dedicated versus non-dedicated wells. Both are summarized below.

3.5.1.1 Dedicated Wells

The instructions below are to be followed at each monitoring well that has a dedicated pump with dedicated tubing:

- Don appropriate PPE as described in the site-specific Health and Safety Plan.
- Brush away soil and/or vegetation, and pump standing water away from the well opening.
- Open the well cap.
- Measure and record the depth to water using a decontaminated water-level meter (EPA 1996). Take all measurements from the northern point on the dedicated pump or at the hatch mark on the well riser. Measure to the nearest 0.01 foot, and record the measurements on the Field Report form and the Non-Aqueous Phase Liquid (NAPL) and Groundwater Level Measurement Summary Form.
- Set up a flow-through cell in preparation for purging. Connect dedicated tubing from the well to the flow-through cell. Set tubing to the correct water depth in accordance with the constituents being sampled for, described in the Work Plan. Turn the pump controller to its lowest setting, set the memory in the flow-through cell to record readings every 3 minutes, and turn on the pump. Begin purging slowly to prevent drawing down the water table.

3.5.1.2 Non-Dedicated Wells

The instructions below are to be followed at each monitoring well that does not have a dedicated pump:

- Don appropriate PPE as described in the site-specific Health and Safety Plan.

- Brush away soil and/or vegetation, and pump standing water away from the well opening.
- Open the well cap.
- Measure and record the depth to water using a decontaminated water-level meter in accordance with SOP No. FAR-100. Take all measurements from the northern point on the dedicated pump or at the hatch mark on the well riser. Measure to the nearest 0.01 foot, and record the measurements on the Field Report form and on the Low Flow Well Purging and Sampling Data Form.
- Connect the silicon tubing to the peristaltic pump. If using a bladder pump, insert the bladder pump and attach the dedicated polyethylene tubing so the pump intake is approximately at the midpoint of the screened interval.
- Set up the pump and the flow-through cell in preparation for purging. Turn the pump to its lowest setting, set the memory in the flow-through cell to record readings every 3 minutes, and turn on the pump. Begin purging slowly to prevent drawing down the water table.

3.5.2 Purging Procedures

The purging instructions below are to be followed at each monitoring well, and apply to both dedicated and non-dedicated wells:

- Begin purging, and initiate water-quality testing for temperature, pH, specific conductivity, dissolved oxygen, oxidation redox potential, and turbidity. Purge all monitoring wells using a peristaltic or bladder pump and dedicated polyethylene and silicon tubing. Record water-quality parameters every 3 minutes.
- Record water levels every 3 minutes, as possible. It is imperative that the water level not drop by more than 1.0 foot during the low-flow purging process.
- Record flow rates every 3 minutes. Ensure that the flow rate does not exceed 500 milliliters per minute during the low-flow purging process.

3.5.3 Purging Requirements

One of the three following requirements must be met before samples can be collected from each monitoring well:

- Drawdown is no greater than 1.0 foot for low-flow sampling, and water-quality parameters have stabilized according to the stability criteria specified below:

Water-Quality Parameter	Stability Criterion
Turbidity	{X} <25 NTU **or** RPD <10% for values {X}>25 NTU
Dissolved oxygen	Δ ≤ 10%
Specific conductivity	RPD ≤ 3%
ORP	Δ <10 mV
pH	Δ ≤ 0.1 unit

Notes
Δ = maximum reading minus minimum
mg/l = milligrams per liter
mV = millivolt
NTU = nephelometric turbidity unit
ORP = oxidation-reduction potential
RPD – relative percent difference

Where:

$$m = \text{mean} = \frac{\text{Max}\ \{X\} + \text{Min}\ \{X\}}{2}$$

{X} = the last three water-quality readings

RPD = $\underline{\Delta}$ x 100%

Δ = Maximum {X} – Minimum {X}

Although a well may not stabilize according to the above criteria under some circumstances, the well can still be sampled if one of the following conditions exists:

- The well does not meet stability criteria due to an instrument accuracy issue. Instrument accuracy often limits the ability to achieve stabilization on a percentage basis. For example, if redox potential consistently fluctuates between 1 and 15 mV, a change in concentration of greater than 10 mV does not meet the stability criterion. However, because the accuracy of the instrument is ±20 mV, the stability criterion would be considered satisfied within the range of accuracy for the instrument. This consideration is particularly important when water-quality parameter values are low. Field personnel must consult the instrument manual to determine the instrument's accuracy range.
- The well does not meet stability criteria due to drawdown. Wells for which all water-quality parameters have stabilized then using low-flow sampling procedures the well may be sampled if it is clear that drawdown will not stabilize before the water level drops below the minimum allowable value (i.e., the pump intake, or the top of the screen if the aquifer is confined).

- The well does not meet stability criteria due to drawdown. The water level drops below the minimum value using low-flow sampling procedures (i.e., the pump intake, or the top of the screen if the aquifer is confined) during purging, the pump should be turned off and the well should be allowed to recover. As long as a minimum of two tubing volumes of water (including the tubing and pump) have been removed from the well, the well should be sampled as soon as the water level has recovered to 80 percent of the prepurge casing volume. Use the following equation to determine the minimum volume of groundwater to remove before sampling when the water level drops below the minimum value:

  Minimum purge volume = 2[500 ml + M(length of tubing in feet)]

  Where: M is the volume (in milliliters) contained in a 1-foot length of tubing

  The value of M is provided below for the inner diameters of tubing listed:

Inner Diameter (Inches)	M (Milliliters)
0.125	2.4
0.25	9.7
0.5	39

  Collecting a sample is acceptable even if water-quality parameters have not stabilized, and one well volume has not been removed.

  Record on the Field Report form and the Low Flow Well Purging and Sampling Data Form if any well did not meet the stabilization and drawdown criteria, and explain the rationale for sampling the well at the time it was sampled.

- If stabilization of the water quality parameters is unachievable but one well volume of groundwater has been removed from the well; or
- The well runs dry twice during the purging procedure.

3.5.4 Sample Collection

During low-flow sampling, do not stop pumping once the purging requirements have been met. Disconnect the sampling tube from the flow-through cell. It is imperative not to lower the water table or disturb the water column. Fill pre-cleaned sample containers using flexible silicon hose or polyethylene tubing on the discharge side of pump.

3.5.5 Post-Sampling

Record the depth to water to determine whether the water level changed from the original reading, as possible.

Close the well or tap appropriately and record any well integrity concerns on the Field Report form and the Low Flow Well Purging and Sampling Data Form.

3.6 DOCUMENTATION

Document the well purging and sampling activities on the Low Flow Well Purging and Sampling Data Form and in the detailed field notebook.

3.7 REFERENCE

U.S. Environmental Protection Agency (EPA). 1996. *Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures*. EPA/540/5-95/504. April.

4.0 SOIL SAMPLING PROCEDURES—BORINGS
SOP NO. FAR-106

4.1 PURPOSE

The purpose of this SOP is to provide soil sampling personnel with the information needed to collect and document soil samples from reconnaissance and monitoring well borings for chemical analyses to ensure consistent and representative sampling.

4.2 APPLICATION

The step-by-step guidelines provided in this SOP are to be followed by the field sampling crew.

4.3 EQUIPMENT

The following equipment is necessary to properly collect soil samples from borings:

- A PID to monitor and record soil headspace readings.
- Applicable soil sampling equipment (e.g., stainless steel spoons and hand trowels, brass or stainless steel sleeves with plastic end cap covers, pre-cleaned sample containers, Teflon tape, stainless steel mixing bowl, stainless steel hand-auger, stainless steel hand-held drive sampler, post-hole auger, wood or steel stakes).
- Materials necessary to provide required documentation (e.g., sample labels, Field Report forms, Log of Boring forms, and Chain of Custody forms.
- PPE as described in the site-specific Health and Safety Plan.
- Decontamination equipment.
- Sampling support equipment (e.g., sample coolers, ice and/or blue ice, bubble wrap, clear tape, duct tape, heavy resealable plastic bags, razor knives, garbage bags, paper towels, distilled water, nitrile gloves).

4.4 DECONTAMINATION

Reusable equipment that will come into contact with soil cuttings or be used to acquire soil samples is to be decontaminated before arrival at the site, between soil samples, upon relocation at the site, and upon exit from the site.

4.5 SOIL SAMPLING PROCEDURES

Sampling procedures differ for hollow-stem auger drilling methods and direct-push drilling techniques. Both are summarized below. The specific drilling and soil sampling equipment used is to be recorded on the Log of Boring form and the Field Report form.

4.5.1 Setup

The instructions below are to be followed at each boring site:

- Suit up in appropriate PPE as described in the site-specific Health and Safety Plan.
- Set up a temporary sampling table adjacent to the drill rig to log and collect soil samples from the soil cores as they are recovered during drilling. Lay plastic sheeting on the table to keep the surface clean and to prevent potential cross-contamination between borings and soil samples. Designate clean areas for decontaminated sampling equipment and pre-cleaned soil sample containers.
- Set up 5-gallon buckets for decontaminating soil sampling equipment between samples. The decontamination buckets are separate from the buckets provided by the drillers for their split spoons and core barrels.
- Calibrate the PID to monitor headspace for selected soil samples in accordance with the equipment manual. Collect headspace readings for individual soil samples by placing the instrument probe into a sample jar or a heavy resealable plastic bag containing a portion of a soil sample; record the reading on the Log of Boring form.
- Upon completion of sampling at a boring, measure its location from an on-site permanent datum.

4.5.2 Hollow Stem Auger Drilling Technique Sample Collection

These procedures have been developed for soil sampling using hollow-stem auger drilling methods. Soil samples collected using hollow-stem-auger drilling methods will be collected using a standard 18-inch-length (6-inch waste barrel) Dames & Moore split-spoon sampler with a 2.5-inch inner diameter that can be used with or without brass or stainless steel liners.

Soil samples collected by direct-push drilling techniques will be collected using either split-spoon samplers or tube samplers having the following specifications:

- A 36-inch-length Standard Penetration Test split-spoon sampler with a 1.5-inch-inner diameter that can be used with or without 6-inch brass or stainless steel sleeves.
- A 22-inch-length large-bore tube sampler with a 1-inch inner diameter that can be used with or without 6-inch brass or stainless steel sleeves, or with a one-piece polyethylene liner.

4.5.3 Direct-Push Drilling Technique Sample Collection

The following sections provide instructions for collecting samples using lined and unlined split-spoon samplers, and tube samplers.

4.5.3.1 Split-Spoon Samplers

The instructions below are to be followed for collection of samples using lined and unlined split-spoon samplers:

- Don a clean pair of nitrile sampling gloves for each individual soil sample collected, and before decontaminating sampling equipment, to avoid potential cross-contamination.
- Insert pre-cleaned liners into a decontaminated split-spoon sampler, attach the sampler to the drill rod, insert into the boring, and drive the samples the required length.
- Upon retrieval of the sampler, wipe excess soil and/or drilling slough material from the outside of the sampler with clean paper towels. Open the sampler and place the split spoons and drill shoe on the sampling table.
- Briefly examine the soil sample visually for obvious signs of contamination, and take PID readings.
- Select the soil sample interval for laboratory analysis and immediately transfer soil into a pre-cleaned sample container(s) using a decontaminated stainless steel spoon. Completely fill the container(s) to the top to minimize headspace, and seal with a Teflon lid. Label the sample container(s) and place into a sampling cooler. Record the sample information on a Chain of Custody form, the Log of Boring form, and the Field Report form.
- Remove the remaining soil sample from the split spoon. Retain a portion of the sample in a heavy resealable plastic bag or a glass sample jar to measure headspace with the PID. Wait approximately 10 minutes before taking the measurement for headspace analysis using the PID. Insert the PID probe tip into a small opening in the top of the bag, and record the PID units on the Log of Boring form.
- Examine the remaining soil sample for lithology using the Unified Soil Classification System, and record the lithology on the Log of Boring form.
- Discard excess soil cuttings into a drum or soil bin.
- Decontaminate the soil sampling equipment and split spoons, and don a clean pair of sampling gloves before collecting the next soil sample.

4.5.3.2 Tube Sampler

The instructions below are to be followed for collection of samples using tube samplers:

- Use the same soil sampling procedures as for the split-spoon sampler, with the exception that the lined tube sampler can also use a one-piece polyethylene liner instead of the 6-inch brass or stainless steel liner.
- When using a one-piece polyethylene liner, select the soil sample interval and cut the liner with a razor knife.

4.6 DOCUMENTATION

Document the soil sampling activities on the Log of Boring and the Chain of Custody form, and in the detailed Field Report form.

4.7 REFERENCES

American Society for Testing Materials. 1989. Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils, Method D-1586-11.

Hazardous Waste Remedial Action Program. 1990. *Quality Control Requirements for Field Methods*. DOE/HWP-69/RI. July.

U.S. Environmental Protection Agency. 1987. *A Compendium of Superfund Field Operation Methods*. EPA Document Number 540-P-87-001. December 1.

____. 1996. *Method 1669 Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels*. July.

5.0 STORMWATER SAMPLING PROCEDURES FOR COLLECTION OF FILTERED SOLIDS SAMPLES
SOP NO. FAR-110

5.1 PURPOSE

The purpose of this standard operating procedure (SOP) is to provide sampling personnel with the information needed to collect stormwater effluent necessary for solids to be filtered and analyzed by the applicable laboratory.

5.2 APPLICATION

This SOP provides the detail necessary for a field sampling crew to collect stormwater effluent necessary for solids to be filtered and collected by the applicable laboratory. Solids will be filtered and collected using a 5-micron filter by the laboratory for analysis for metals and polychlorinated biphenyls (PCBs).

5.3 EQUIPMENT

The equipment listed below is necessary for the collection of stormwater effluent that will be filtered to collect solids samples. Specific sampling equipment used will be recorded in the field notes.

- A totalizing flow meter.
- All required documentation materials, including sample labels, field notes, and Chain of Custody forms.
- Personal protective equipment (PPE) as described in the site-specific Health and Safety Plan.
- Sampling support equipment (e.g. sample coolers, ice and/or blue ice, bubble wrap, clear tape, duct tape, heavy resealable plastic bags, razor knives, garbage bags, paper towels, distilled water, nitrile gloves), as needed.

5.4 DECONTAMINATION

All sampling equipment that will be used is disposable.

5.5 STORMWATER SAMPLING PROCEDURES FOR COLLECTION OF FILTERED SOLIDS SAMPLES

The stormwater sampling procedures have been developed for use in the collection of solids from stormwater treatment system effluent.

5.5.1 Set-Up

The instructions below are to be followed by field staff upon arrival at the Site:

- Suit up in appropriate PPE as described in the site-specific Site Health and Safety Plan.
- Record weather conditions at the time of sampling and the date of the last known rainfall event(s).
- Include potential sources of solids or contaminants such as construction activities, erosion, equipment storage or use, waste or material storage, vehicles, exhaust vents, on-site processes in the field notebook. Note site features, distances, flow directions, and gradients, in the field notebook or sketch them on a site map.
- Note the presence of water, visible flows, signs of flooding, clogging, debris in or around the Site, blocked inlets and/or outlets at a catch basin, staining, etc. in the field notebook.
- Note any apparent evidence of contamination in the stormwater effluent such as odor, sheen, discoloration of water or solids in the field notebook.

1.5.2 Sample Collection

The instructions below are to be followed by field staff in collecting samples of stormwater effluent that will be filtered for solids by the laboratory using a 5-micron filter:

- Don clean nitrile gloves prior to touching the sample containers. Record the sample name on the 25 liter plastic sample container.
- Open the stormwater sampling effluent sample port. Record the stormwater effluent flow rate in the field notebook.
- Fill up the 25 liter plastic sample container with stormwater effluent. Once full close the container.
- Label the bag with the following information: client name, project name and number, date and time sampled, sample identification, and sampler initials.
- Place the sample container into a cooler or larger container chilled to 4°Celsius.
- Transport sample to laboratory certified to perform this work immediately for filtering using a 5-micron filter.

5.6 DOCUMENTATION

The stormwater effluent sampling activities will be documented in the field notebook and on the Chain of Custody form.

APPENDIX C
FIELD FORMS

ADDENDUM NO. 1 TO THE OPERATIONS, MONITORING, AND MAINTENANCE PLAN, BASIS OF DESIGN REPORT
Jorgensen Forge Early Action Area Removal Action
U.S. Environmental Protection Agency Docket No. CERCLA-10-2013-0032
Seattle, Washington

Farallon PN: 831-032

FARALLON CONSULTING

Log of Boring:

Page __ of __

Client:	**Date/Time Started:**
Project:	**Date/Time Completed:**
Location:	**Equipment:**
Farallon PN:	**Drilling Company:**
Logged By:	**Drilling Foreman:**
	Drilling Method:

Sampler Type:
Drive Hammer (lbs.):
Depth of Water ATD (feet bgs):
Total Boring Depth (feet bgs):
Total Well Depth (feet bgs):

Depth (feet bgs)	Sample Interval	Lithologic Description	USCS	USGS Graphic	% Recovery	Blow Counts 8/8/8	PID (ppm*)	Sample ID	Sample Analyzed	Boring/Well Construction Details
0										
5										
10										
15										
20										

Well Construction Information

Monument Type:
Casing Diameter (inches):
Screen Slot Size (inches):
Screened Interval (ft bgs):

Filter Pack:
Surface Seal:
Annular Seal:

Ground Surface Elevation (ft):
Top of Casing Elevation (ft):
Boring Abandonment:
Surveyed Location: X: Y:

MONITORING WELL CONSTRUCTION DATA

WELL/BORING NO:		
PROJECT NO:	PROJECT NAME:	PERMIT NO:
DATE:	SITE ADDRESS:	

WELL SITE LOCATION PLAN:

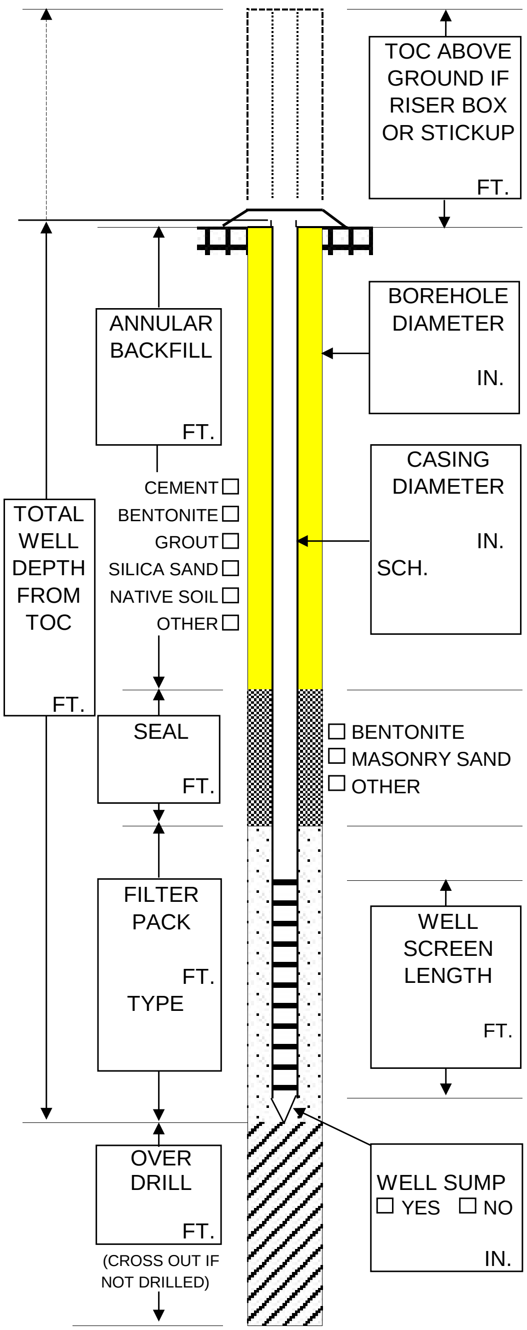
SEC: TWN: RGE: LAT: LONG:

DRILLING CO:

DRILL CREW:

WELL TYPE: ☐ SHALLOW ☐ SINGLE CASED ☐ MONITORING
☐ PERMANENT ☐ INTERMEDIATE ☐ DOUBLE CASED ☐ RECOVERY
☐ TEMPORARY ☐ DEEP ☐ OTHER ☐ OTHER

WELL SCHEMATIC



INSTALLATION DATA

DECON. ☐ STEAM CLEAN ☐ HIGH PRESSURE WASH
☐ SOAP WASH ☐ OTHER

CASING TYPE: ☐ PVC ☐ STAINLESS ☐ TEFLON ☐ OTHER
JOINTS: ☐ THREADED ☐ WELDED ☐ COUPLED
☐ SCREWED ☐ OTHER
PIT CASING: ☐ YES ☐ NO ☐ DESCRIBE

WELL SCREEN: ☐ PVC ☐ STAINLESS ☐ TEFLON ☐ OTHER
DIAMETER: ☐ 2" ☐ 4" ☐ 6" ☐ OTHER ____ IN
SLOT: ☐ 0.010 ☐ 0.020 ☐ OTHER ____ IN

DRILLING METHOD: ☐ SOLID STEM ☐ HOLLOW STEM ☐ MUD ROTARY
☐ AIR ROTARY ☐ DIRECT PUSH ☐ HAND AUGER
☐ OTHER
BIT SIZE: ☐ 2" ☐ 4" ☐ 6" ☐ 8" ☐ 12" ☐ OTHER ____ IN
DRILLING MUD: ☐ NONE ☐ WATER ☐ BENTONITE
☐ OTHER
CENTRALIZER: ☐ YES ☐ NO

COMPLETION: ☐ FLUSH MOUNT ☐ STICKUP ☐ RISER BOX
LOCK TYPE: ☐ DOLPHIN ☐ MASTER KEY NO.
☐ OTHER
PAD: ☐ 2'X2' ☐ 4'X4' ☐ OTHER

CUTTINGS: ☐ DRUMMED NUMBER OF DRUMS
☐ SPREAD ☐ OTHER

DEVELOPMENT METHOD: ☐ NONE ☐ BAILING ☐ PUMPING ☐ AIR LIFT
☐ SURGE & BLOCK ☐ OTHER
TIME: ☐ 10 MIN ☐ 20 MIN ☐ OTHER ____ MIN
AMOUNT ☐ 5 GAL ☐ 10 GAL ☐ OTHER ____ GAL
WATER BEFORE: ☐ SILTY ☐ TURBID ☐ OPAQUE ☐ CLEAR
WATER AFTER: ☐ SILTY ☐ TURBID ☐ OPAQUE ☐ CLEAR
EVIDENT ODOR: ☐ YES ☐ NO TYPE

DEVELOPMENT WATER: ☐ DRUMMED NUMBER OF DRUMS
☐ SPREAD ☐ TREATED ☐ POTW ☐ OTHER

WATER LEVEL: INITIAL ____ FT ☐ BTOC ☐ BLS

DATE: ____ ____ FT BELOW TOC

DATE: ____ ____ FT BELOW TOC

NOTES: (DESCRIBE ALL NON-STANDARD METHODS & MATERIALS)

PREPARED BY:

LOW FLOW WELL PURGING AND SAMPLING DATA

			WELL NO:
DATE:	PROJECT NAME:		PROJECT NO:
WEATHER CONDITIONS:			
WELL DIAMETER (IN.) ☐ 1 ☐ 2 ☐ 4 ☐ 6 ☐ OTHER ________			
SAMPLE TYPE: ☐ GROUNDWATER ☐ WASTEWATER ☐ SURFACE WATER ☐ OTHER			
WELL DEPTH (TOC) FT.		DEPTH TO WATER BEFORE PURGING (TOC) FT.	
LENGTH OF WATER FT.		CALCULATED ONE WELL VOLUME[1]: GAL.	
DEPTH OF SAMPLE POINT FT.		ESTIMATED VOLUME PURGED GAL.	
EQUIP. DECON. ☐ ALCONOX WASH ☐ LIQUINOX WASH ☐ DIST/DEION 1 RINSE ☐ DIST/DEION 2 RINSE ☐ OTHER			
CONTAINER PRESERVATION: ☐ LAB PRESERVED ☐ FIELD PRESERVED			
WATER ANALYZER:	PUMP TYPE:		TUBING:

ACTUAL TIME (min)	FLOW RATE (ml/min)	DEPTH TO WATER (feet)	TEMP ☐ °F ☐ °C	SPECIFIC CONDUCT.	pH	DISS. OXYGEN (mg/l)	TURBIDITY (NTU)	ORP (mV)	REMARKS
			(+/- 0.1°)	(+/- 3%)	(+/- 0.1)	(+/- 10%)	(NA)	(+/- 10 mV)	(EVIDENT ODOR, COLOR, PID)
	INITIAL		--	--	--	--	--	--	

DEPTH TO WATER AFTER PURGING (TOC) FT.	SAMPLE FILTERED ☐ YES ☐ NO SIZE ______
NOTES:	SAMPLE TIME: ID#
	DUPLICATE ☐ TIME: ID#:
	EQUIP. BLANK: ☐ TIME: ID#:
	PREPARED BY:

[1] A 1 FOOT LENGTH OF WATER = 0.05 GAL IN 1" DIA. PIPE 0.17 GAL IN 2" DIA PIPE 0.65 GAL IN 4" DIA PIPE 1.5 GAL IN 6" DIA PIPE

STORMWATER SAMPLE COLLECTION FORM

Jorgensen Forge Facility, Seattle, Washington

Monitoring Event: ________________________ **Sample Date/Time:** ______________________________

Sampler Name: ________________________ **Signature** ______________________________

Sample Location	Monitoring Point-Outfall 003
Stormwater sample collected? If no explain why in comments below.	
Sample time (one time grab).	
Sample collected within first 12 hours of discharge event? If no, explain in comments below.	
Sample appearance (i.e.; clear, slightly cloudy, cloudy, floating materials)	
Stormwater pH using meter or narrow-range indicator paper.	
Visible sheen present?	
Turbidity Reading (NTU):	
Comments:	

APPENDIX D
QUALITY ASSURANCE PROJECT PLAN

ADDENDUM NO. 1 TO THE OPERATIONS, MONITORING, AND MAINTENANCE PLAN, BASIS OF DESIGN REPORT
Jorgensen Forge Early Action Area Removal Action
U.S. Environmental Protection Agency Docket No. CERCLA-10-2013-0032
Seattle, Washington

Farallon PN: 831-032

Washington
Issaquah | Bellingham | Seattle

Oregon
Portland | Bend

California
Oakland | Sacramento | Irvine

QUALITY ASSURANCE PROJECT PLAN

APPENDIX D OF ADDENDUM NO. 1 TO THE OPERATIONS, MONITORING, AND MAINTENANCE PLAN, BASIS OF DESIGN REPORT

JORGENSEN FORGE EARLY ACTION AREA REMOVAL ACTION SEATTLE, WASHINGTON

Submitted by:
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975 5th Avenue Northwest
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Farallon PN: 831-032

For:
U.S. Environmental Protection Agency
Region 10
1200 Sixth Avenue
Seattle, Washington 98101

On behalf of:
Earle M. Jorgensen Company

May 22, 2015

Prepared by:

Emerald Erickson-Mulanax

Emerald Erickson-Mulanax
Project Geologist

Reviewed by:

Amy Essig Desai

Amy Essig Desai
Principal

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ATTACHMENT

Attachment 1 Analytical Resources, Inc. Quality Assurance Plan

ACRONYMS AND ABBREVIATIONS

Action Memo	*Action Memorandum for a Non-Time Critical Removal Action at the Jorgensen Forge Early Action Area of the Lower Duwamish Waterway Superfund Site in Seattle, Washington* dated October 7, 2011, prepared by the U.S. Environmental Protection Agency.
ARI	Analytical Resources, Inc.
BODR	*Basis of Design Report, Jorgensen Forge Early Action Area* dated August 2013 prepared by Anchor QEA, LLC
°C	degrees Celsius
COC	chain of custody
DQOs	data quality objectives
EDDs	electronic data deliverables
EMJ	Earle M. Jorgensen Company
EPA	U.S. Environmental Protection Agency
Facility	Jorgensen Forge Corporation facility in Seattle, King County, Washington
Farallon	Farallon Consulting, L.L.C.
Jorgensen Forge	Jorgensen Forge Corporation
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
LDW	Lower Duwamish Waterway
MS	matrix spike
MSD	matrix spike duplicate
NTCRA	Non-Time-Critical Removal Action conducted on a portion of the Lower Duwamish Waterway Superfund site adjacent to the Jorgensen Forge facility in Seattle, Washington
OMMP	Operations, Monitoring, and Maintenance Plan
OMMP Addendum No. 1	Addendum No. 1 to the Operations, Monitoring, and Maintenance Plan, Basis of Design Report dated May 22, 2015, prepared by Farallon Consulting, L.L.C.
PCBs	polychlorinated biphenyls
QA	quality assurance
QAPP	Quality Assurance Project Plan

QA/QC	quality assurance/quality control
QC	quality control
RPD	relative percent difference
SOPs	standard operating procedures

1.0 INTRODUCTION

This Quality Assurance Project Plan (QAPP) was prepared on behalf of Earle M. Jorgensen Company (EMJ) pursuant to the Administrative Settlement Agreement and Order on Consent for Removal Action Implementation (U.S. Environmental Protection Agency [EPA] Region 10 Comprehensive Environmental Response, Compensation, and Liability Act Docket No. 10-2013-0032 and attached Statement of Work. The QAPP is Attachment B of Addendum No. 1 to the Operations, Monitoring, and Maintenance Plan (OMMP), Basis of Design Report (BODR) dated May 22, 2015, prepared by Farallon Consulting, L.L.C. (Farallon) (OMMP Addendum No. 1). The BODR was prepared by Anchor QEA LLC (2013) for the cleanup of contaminated sediments and associated bank soil in a portion of the Lower Duwamish Waterway (LDW) Superfund Site adjacent to the Jorgensen Forge Corporation (Jorgensen Forge) facility in Seattle, King County, Washington (herein referred to as the Facility). The cleanup was conducted as a Non-Time-Critical NTCRA (NTCRA) in accordance with the EPA (2011) selected cleanup alternative documented in the *Action Memorandum for a Non-Time Critical Removal Action at the Jorgensen Forge Early Action Area of the Lower Duwamish Waterway Superfund Site in Seattle, Washington*, which was detailed in the *Final Engineering Evaluation/Cost Analysis – Jorgensen Forge Facility, 8531 East Marginal Way South, Seattle, Washington* (Anchor QEA LLC 2011) (Action Memo).

The QAPP describes the quality assurance/quality control (QA/QC) procedures that will be implemented as part of the groundwater and stormwater monitoring phase of the NTCRA. The purpose of the QAPP is to ensure that the data generated are of sufficient quality to meet the sampling objectives as described in the BODR, OMMP, and OMMP Addendum No. 1.

The QAPP was prepared in accordance with the EPA (2001a) *Requirements for Quality Assurance Project Plans*, the *EPA (*2002) *Guidance for Quality Assurance Project Plans*, and the *EPA* (2001b) *Requirements for Quality Management Plans*. Laboratory analytical work will be performed in accordance with the specified analytical methods, the data quality objectives (DQOs), and the QAPP.

2.0 PROJECT ORGANIZATION AND QAPP DISTRIBUTION

This section identifies key project personnel, responsibilities of the team members, and Laboratory Project Managers. Distribution of the QAPP also is covered in this section.

Because the individuals listed below may change over time, the QAPP has been written to include "designee" as an alternate to the team member currently identified. The following paragraphs define the functional responsibilities of each team member.

2.1 MANAGEMENT

The Farallon Project Manager is Ms. Amy Essig Desai, whose primary role is to ensure compliance with the requirements of this QAPP. Ms. Desai will have a direct line of communication with EMJ, and is responsible for implementing activities described in the QAPP. She also will be responsible for the production of work plans and project deliverables, and performance of the administrative tasks needed to ensure timely and successful completion of the work. She will provide overall program guidance to support staff, and will ensure that the documents, procedures, and project activities meet the objectives presented in the QAPP. Ms. Desai will be responsible for resolving project concerns or conflicts related to technical matters.

The EPA Project Manager is Ms. Rebecca Chu.

2.2 FIELD COORDINATOR

Ms. Emerald Erickson-Mulanax will serve as the Farallon Field Coordinator, responsible for day-to-day technical and QA/QC oversight. She will ensure that appropriate protocols for sample collection, preservation, and holding times are observed, and will submit environmental samples to the designated laboratories for chemical and physical analyses.

2.3 QUALITY ASSURANCE/QUALITY CONTROL MANAGERS

Mr. Gerald J. Portele will serve as the Farallon QA/QC Manager, providing QA/QC oversight for both the field sampling and laboratory programs, ensuring that samples are collected and documented appropriately, coordinating with the analytical laboratories, ensuring data quality, overseeing data validation, and supervising project quality assurance (QA) coordination and data validation. Ms. Gina Grepo-Grove will serve as the EPA QA/QC Manager for EPA.

2.4 DATA MANAGER

Ms. Erickson-Mulanax will serve as the Farallon Data Manager, and will compile field observations and analytical data into a database, review the data for completeness and consistency, append the database with qualifiers assigned by the data validator, and ensure that the data obtained are in a format suitable for inclusion in the appropriate databases and delivery to EPA.

2.5 LABORATORY PROJECT MANAGER AND DATA VALIDATION MANAGER

Mr. Mark Harris of Analytical Resources, Inc. (ARI) will serve as the Laboratory Project Manager, overseeing laboratory operations associated with the receipt of environmental samples, chemical and physical analyses, and laboratory report preparation for this project. Ms. Christine Ransom of EcoChem, Inc. (EcoChem) will serve as the primary contact for performance of data validation.

The analytical testing laboratories will be responsible for the following tasks:

- Performing the methods outlined in the QAPP, including those referenced for each analytical procedure;
- Adhering to documentation, custody, and sample logbook procedures;
- Meeting reporting and QA/QC requirements;
- Delivering electronic data files as specified in the QAPP;
- Meeting turnaround times for deliverables as described in the QAPP; and
- Allowing EPA and the Farallon QA/QC Manager to perform laboratory and data audits.

2.6 QAPP DISTRIBUTION

The following individuals will receive an electronic copy of the approved QAPP:

- EPA Project Manager Ms. Chu
- EPA QA/QC Manager Ms. Gina Grepo-Grove
- EMJ Mr. Gil Leon
- Jorgensen Forge Mr. Miles Dyer
- Farallon Project Manager Ms. Desai
- Farallon QA/QC Manager Mr. Portele
- Farallon Field Coordinator/Data Manager Ms. Erickson-Mulanax

The following Laboratory Project Managers will receive one electronic copy of the approved QAPP:

- ARI Laboratory Project Manager Mr. Harris
- EcoChem Project Manager Ms. Christine Ransom

3.0 PROJECT DESCRIPTION

Post-NTCRA groundwater and stormwater monitoring data will be collected as described in OMMP Addendum No. 1 and the Construction Quality Assurance Plan, Appendix D of the BODR. Data collection approaches and objectives are discussed in detail in OMMP Addendum No. 1. Post-NTCRA long-term groundwater and stormwater monitoring will be performed to confirm that performance standards are being met in the years following construction, and to demonstrate that Facility source controls are effectively protecting the quality of adjacent river sediments and preventing their recontamination. Groundwater and stormwater monitoring will be performed from 2015 through 2017. Proposed sampling locations are shown on Figure 1.

4.0 DATA QUALITY OBJECTIVES AND CRITERIA

DQOs provide a qualitative and quantitative framework and series of planning steps based on the scientific method around which data collection programs can be designed. The use of DQOs ensures that:

- The objectives of the monitoring are clearly defined;
- The type, quantity, and quality of environmental data used in decision making are appropriate for their intended application; and
- Acceptable levels of decision error and performance goals are specified, such that the quantity and quality of data needed to support management decisions are provided.

4.1 ANALYTICAL DATA QUALITY OBJECTIVES

The purpose of this QAPP is to outline the QA/QC measures necessary to ensure that the results from the compliance groundwater, stormwater, and solids monitoring are of the type and quality needed to demonstrate that upland source controls at the Site are effectively minimizing the potential for sediment recontamination as stated in the Action Memo.

The objectives of the groundwater, stormwater, and solids monitoring are to confirm that performance standards are being met in the years following the NTCRA construction activities, and to demonstrate that the Site source controls are effectively protecting the quality of adjacent river sediments and preventing their recontamination.

The groundwater, stormwater, and solids monitoring objectives are to:

- Evaluate whether metals and polychlorinated biphenyl (PCB)-containing materials are being transported by the stormwater conveyance system and released to sediments in the LDW via Outfall 003; and
- Evaluate whether metals and PCB-containing materials are being transported through the groundwater pathway to sediments in the LDW.

4.2 MEASUREMENT QUALITY INDICATORS FOR CHEMICAL DATA

Reporting limit goals for groundwater and stormwater sampling parameters are presented in Table 5 of OMMP Addendum No. 1.

The overall QA/QC objective of the QAPP is to develop and implement procedures for sampling, chain of custody (COC), laboratory analysis, instrument calibration, data reduction and reporting, internal quality control (QC), audits, preventive maintenance, and corrective action such that valid data will be generated. These procedures are presented or referenced in following sections of the QAPP. Specific QA/QC procedures are discussed in Section 13, Instrument and Equipment Calibration Procedures and Frequency. Project-specific control limits will be used to assess analytical performance with regard to precision and completeness, and are outlined in Table 1. Data representativeness will be addressed by the sample quantities and locations identified in OMMP Addendum No. 1. Data comparability will be achieved through the use of standard EPA-approved methods. Data completeness will be assessed at the conclusion of analytical activities.

QC indicators are generally defined in terms of five parameters:

- Precision;
- Accuracy;
- Representativeness;
- Comparability; and
- Completeness.

Each parameter is defined below. Specific QA objectives for sample collection and analyses are set forth in other sections of the QAPP, as referenced below.

4.2.1 Precision

Precision is a measure of the reproducibility of sample results. The goal is to maintain a level of analytical precision consistent with the objectives of the action. To maximize precision, sampling and analytical procedures will be followed. Work for this project will adhere to established protocols as presented in the QAPP. Analytical precision will be measured through laboratory control samples (LCSs) and laboratory control sample duplicates (LCSDs), and matrix spikes (MSs) and matrix spike duplicates (MSDs) for organic analyses, and laboratory duplicate samples for inorganic analyses. Analytical precision measurements will be carried out on project-specific samples at a minimum frequency of one per laboratory analysis group, or 1 in 20 samples, whichever is more frequent, per matrix analyzed as outlined in Table 2. Laboratory precision will be evaluated against project-required control limits outlined in Table 1.

Field precision will be evaluated by the collection of blind field duplicates at a frequency of 5 percent. Field duplicate precision will be screened against a relative percent difference (RPD) of 35 percent for groundwater and stormwater samples, although no data will be qualified based solely on field duplicate precision.

The equation used to express precision is:

$$RPD = \frac{(A-B)}{\frac{(A+B)}{2}}\ x\ 100\%$$

where:
A = Analytical result from one of two duplicate measurements
B = Analytical result from the second measurement

Precision measurements can be affected by how close a chemical concentration is to the reporting limit, which can increase the percent error (expressed as RPD). When a sample or duplicate concentration is within five times the reporting limit, alternative control limits recommended by EPA (1999) of one time +/– the reporting limit for water will be used.

4.2.2 Accuracy

Accuracy is a measure of how close a measured result is to the true value. Both field and analytical accuracy will be monitored through initial and continuing calibration of instruments. In addition, reference standards, MSs, blank spikes, LCSs, and surrogate standards will be used to assess the accuracy of the analytical data. Accuracy measurements will be carried out at a minimum frequency of 1 per 20 samples per matrix analyzed. Because MSs and MSDs measure the effects of potential matrix interferences for a specific matrix, the laboratory will report MSs and/or MSDs on only project-specific samples. Surrogate recoveries will be determined for every sample analyzed for organics.

Laboratory accuracy will be evaluated against project-specific control limits outlined in Table 1. Accuracy can be expressed as a percentage of the true or reference value, or as percent recovery in analyses where reference materials are not available and spiked samples are analyzed. The equation used to express accuracy is:

$$Percent\ Recovery = \frac{A-X}{B}\ x\ 100\%$$

where:
A = Value measured in spiked sample or standard
X = Value measured in original sample
B = True value of amount added to sample or true value of standard

4.2.3 Representativeness

Representativeness is the degree to which sample data accurately and precisely represent conditions in the project area. Representativeness is dependent on sampling and analytical variability and the variability of environmental media. The OMMP presents the rationale for sample quantities and sampling locations. In addition, use of the prescribed field and laboratory analytical methods and associated holding times and preservation requirements is intended to provide representative data.

4.2.4 Comparability

Comparability is the degree of confidence with which one data set can be compared to another. Comparability will be maintained through consistent use of the sampling and analytical methodologies set forth in the QAPP, and through the use of established QA/QC procedures and appropriately trained personnel.

4.2.5 Completeness

Completeness is defined as a measure of the amount of valid data obtained from an event or investigation compared to the total amount obtained. Completeness (C) will be calculated as follows:

$$C = \frac{[(\text{number of acceptable data points}) \text{ x } 100]}{(\text{total number of data points collected})}$$

The DQO for completeness for all components of this project is 95 percent. Data that have been qualified as estimated because the QC criteria were not met will be considered valid for the purpose of assessing completeness. Data that have been qualified as rejected will not be considered valid for the purpose of assessing completeness.

5.0 SPECIAL TRAINING AND CERTIFICATION

It is important that field crews are trained in standardized groundwater monitoring and stormwater sampling procedures and requirements, so that data collected during groundwater monitoring and stormwater sampling activities are consistent among field crew staff. All field crew staff are fully trained in the collection and processing of groundwater and stormwater samples, decontamination protocols, visual inspections, and COC procedures. All field crew staff also are required to be certified in 40-Hour Hazardous Waste Operations and Emergency Response, with 8-Hour Refresher Training, as applicable. Training and certifications for field crew staff are documented in the personnel files at the Farallon, ARI, and EcoChem offices. Table 3 presents the special training and certifications of project personnel.

6.0 DOCUMENTATION AND RECORD KEEPING

ARI will be required to provide the following in a laboratory report, where applicable:

- **Project Narrative**. This summary, presented in a cover letter, will discuss problems, if any, encountered during any aspect of analysis. This summary will discuss but not be limited to QC, sample shipment, sample storage, and analytical difficulties. Any actual or perceived problems identified and their resolution will be documented with as much detail as appropriate.
- **COC Records**. Legible copies of the COC forms will be provided as part of the data package. This documentation will include the time of receipt and the condition of each sample received by the laboratory. Additional internal tracking of sample custody by the laboratory also will be documented.
- **Sample Results**. The data package will summarize the results for each sample analyzed. The summary will include the following information, where applicable:
    - Field sample identification code and the corresponding laboratory identification code;
    - Sample matrix;
    - Date of sample extraction;
    - Date and time of analysis;
    - Weight and/or volume used for analysis;
    - Final dilution volumes or concentration factor for the sample;
    - Identification of the instrument used for analysis;
    - Method detection limits;
    - Method reporting limits;
    - Analytical results with reporting units identified; and
    - Data qualifiers and their definitions.
- **QC Summaries.** This section will contain the results of the laboratory QC procedures. Each QC sample analysis will be documented with the same information required for the sample results (see above). No recovery or blank corrections will be made by the laboratory. The required summaries are listed below; additional information may be requested.
- **Calibration Data Summary.** This summary will report the concentrations of the initial calibration and daily calibration standards, and the date and time of analysis. The response factor, percent relative standard deviation, percent difference, r-value, and

retention time for each analyte will be listed, as appropriate. Results for standards to indicate instrument sensitivity will be documented.

- **Internal Standard Area Summary.** The area counts of internal standard areas will be reported and compared to method criteria.
- **Method Blank Analysis.** The method blank analyses associated with each sample and the concentrations of all compounds of interest will be reported.
- **Surrogate Spike Recovery.** Surrogate spike recovery data for organic compounds will be included. The names of compounds added, percent recoveries, and range of acceptable recoveries will be listed.
- **Matrix Spike Recovery.** Matrix spike recovery data for applicable analyses will be reported. The names and concentrations of compounds added, percent recoveries, and range of acceptable recoveries will be listed. The RPD for all MSD analyses will be included.
- **Matrix Duplicate.** RPD values for all matrix duplicate analyses will be reported.
- **Laboratory Control Sample.** LCS recovery data will be reported. The names and concentrations of compounds added, percent recoveries, and range of acceptable recoveries will be listed. The RPD for LCSD analyses will be included.
- **Relative Retention Time.** The relative retention time of each analyte detected in the samples will be reported for both primary and confirmational analyses.
- **Original Data.** A PDF of legible copies of original data generated by the laboratory will include:
  - Sample extraction, preparation, and cleanup logs;
  - Instrument specifications and analysis logs for all instruments used on days of calibration and analysis;
  - Reconstructed ion chromatograms for samples, standards, blanks, calibrations, spikes, replicates, and reference materials;
  - The spectra of detected compounds, with associated best-match spectra for each sample;
  - Printouts and quantitation reports for each instrument used, including reports for samples, standards, blanks, calibrations, spikes, replicates, and reference materials;
  - Original data quantification reports for each sample; and
  - Original data for blanks and samples not reported.

The data from this project will be stored electronically in Farallon's project files. In addition to the PDF laboratory report that includes the elements in the bulleted list above, the laboratory will provide results in Farallon's custom EQuIS four-file format.

7.0 SAMPLING PROCESS DESIGN

The sampling process design is summarized below, described in detail in OMMP Addendum No. 1, and presented below in Table 4, which includes a list of the sample latitude/longitude location, number of samples to be collected, matrix, parameters, sample size, container size and type, holding times, preservation techniques, and limits of quantitation for the groundwater, stormwater, solids, and soil samples. The stormwater and groundwater sampling is being performed to confirm that groundwater in the water-bearing zone of EMJ NTCRA dredged sediments, and stormwater discharging from the Facility do not contain concentrations of the metals arsenic, cadmium, chromium, copper, lead, mercury, silver, or zinc, or PCBs that could result in recontamination of shoreline bank and in-water sediments.

Appendix D--QAPP Table 4
Groundwater, Stormwater, Solids, and Soil Sampling Information

Location	Sample Location (Lat/Long)	No. of samples to be collected over 3 years	Matrix	Parameters to be analyzed for each sample	Sample Size	Container Size and Type	Holding Time	Sample Preservation Technique	LOQ
SW System Effluent Port	N: 195426.94 E: 1276288.86 (approximate)	2 to 12 (2 total, up to 4 annually)	Solids	Metals	1 oz.	25 liter plastic container filtered with 5 micron filter by laboratory	6 months	Cool/4°C	5.0 mg/kg wet weight (except Mercury is 0.025 mg/kg-wet weight)
				PCBs	2 oz.	25 liter plastic container filtered with 5 micron filter by laboratory	14 days	Cool/4°C	0.02 mg/kg wet weight
				TOC	1 oz.	25 liter plastic container filtered with 5 micron filter by laboratory	14 days	Cool/4°C	200 mg/kg
		6 to 12 (2 to 4 annually)	Stormwater	Metals, dissolved	500 ml	500 ml HDPE	6 months	HNO_3 to pH < 2	0.01 µg/l (except Mercury is 0.0004)
				Metals, total	500 ml	500 ml HDPE	28 days	HNO_3 to pH < 3	
				PCBs	1,000 ml	1 x 1,000 ml amber glass	7 days until extraction	Cool/4°C	0.01 µg/l
							40 days after extraction (hexane solvent used for extraction)	Cool/4°C	
MW-52	N: 195659.56 E: 1275893.45	3 (1 annually)	Groundwater	Metals, dissolved	500 ml	500 ml HDPE	6 months	HNO_3 to pH < 2	0.01 µg/l (except Mercury is 0.0004)
				Metals, total	500 ml	500 ml HDPE	28 days	HNO_3 to pH < 3	
MW-53	N: 195524.78 E: 1275958.29 (tentative)			PCBs	1,000 ml	1 x 1,000 ml amber glass	7 days until extraction	Cool/4°C	0.01 µg/l
MW-54	N: 195384.06 E: 1276013.20 (tentative)						40 days after extraction (hexane solvent used for extraction)	Cool/4°C	
		Approx. 6 (one-time event)	Soil	Metals	4 oz.	4 oz. glass jar	6 months	Cool/4°C	5.0 mg/kg wet weight (except Mercury is 0.025 mg/kg-wet weight)
				PCBs	8 oz.	8 oz. glass jar	14 days	Cool/4°C	0.02 mg/kg wet weight

NOTES:

°C = degrees Celsius
µg/l = micrograms per liter
E =easting in North American Datum 1983
EAA = Early Action Area
HDPE = high-density polyethylene
HNO_3 = nitric acid
LOQ = limit of detection
ml = milliliter
mg/kg = milligrams/kilogram
N = northing in North American Datum 1983
oz = ounce
PCBs = polychlorinated biphenyls
TOC = total organic carbon

8.0 SAMPLING METHODS

Sampling methods are explained in detail in OMMP Addendum No. 1, and will include the following actions:

- Stormwater sampling will be performed in accordance with the Washington State Department of Ecology (2003) sampling guidance *How To Do Stormwater Sampling - A Guide For Industrial Facilities* published in 2003, revised in 2010.
- Confirmation stormwater samples will be collected from the effluent port located down-gradient of the stormwater treatment system conveyance line for Outfall 003 within 12 hours of stormwater discharge or as soon as practicable.
- Visual observations, pH, and turbidity of stormwater; and temperature, pH, conductivity, dissolved oxygen, and turbidity of groundwater will be recorded in the field.
- Groundwater samples will be collected in accordance with the EPA (1996) guidance document *Low-Flow (Minimal Drawdown) Groundwater Sampling Procedures*.
- Monitoring wells will be purged at a low-flow rate, and groundwater samples will be collected directly from the pump outlet following stabilization of temperature, pH, conductivity, and dissolved oxygen.
- Stormwater and groundwater samples for dissolved metals will be filtered in the field using a 0.45-micron filter.

9.0 SAMPLE HANDLING AND CUSTODY

Sample documentation is a critical aspect of environmental investigations. Sample possession and handling must be traceable from the time of sample collection, through laboratory and data analysis, to the time sample results are potentially introduced as evidence. A sample log form and field logbook entries will be completed for each location occupied and each sample collected. Documentation procedures for sampling are provided in OMMP Addendum No. 1.

9.1 SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIME REQUIREMENTS

Pre-cleaned, certified sample containers, which will be provided by the contracted analytical laboratory, will be used for all groundwater and stormwater samples that will be analyzed by the laboratory. Specific types and sizes of containers for each parameter, holding times, and preservation requirements are listed in Table 4.

Sample containers for conventional parameters, metals, and organics will be cleaned to EPA protocols. Certifications attesting to the cleanliness of pre-cleaned containers are required for containers used for organic analyses and will be maintained by the laboratory.

Sample custody seals and packing materials for filled sample containers will be provided by the analytical laboratory. The filled and labeled containers will be placed into a cooler on ice and carefully packed to eliminate the possibility of container breakage.

9.2 SAMPLE PACKING, HANDLING, AND SHIPPING

Sample packaging and shipment procedures are designed to ensure that the samples will arrive at the laboratory with the COC form intact. Samples will be either hand-delivered to the laboratory or delivered via courier.

Samples will be packaged by field personnel for shipment as described below:

- Sample labels will be checked to ensure that they are securely affixed to the sample containers; clear packing tape will be used, if necessary.
- Caps on the sample containers will be checked to ensure that they are properly sealed.
- The COC form will be completed with the required sampling information, and checked to ensure that recorded information matches sample labels. If the designated sampler relinquishes the samples to other sampling or field personnel for packing or other purposes, the sampler will complete the COC form prior to such a transfer. The appropriate personnel will sign and date the COC form to document the transfer of sample custody.
- Sample containers will be wrapped in bubble wrap or other cushioning material.

- Sample containers will be placed in zip-top bags to prevent cross-contamination.
- One to two inches of cushioning material will be placed at the bottom of the cooler.
- The sealed sample containers and a temperature blank will be placed in the cooler.
- Ice will be placed in plastic bags and the bags will be sealed. The ice-filled bags will be loosely placed in the cooler.
- Remaining space in the cooler will be filled with cushioning material.

Samples will be transported as low-concentration environmental samples and either delivered by an express carrier or picked up by a laboratory courier. Shipments will be accompanied by the COC form identifying contents. The original COC form will accompany the shipment; copies will be retained by the sampler for sampling office records. If the samples are sent by express carrier, a bill of lading will be used. Receipts or bills of lading will be retained as part of the permanent project documentation. Commercial carriers are not required to sign the COC form as long as the form is sealed inside the sample coolers and the custody seals remain intact.

9.3 SAMPLE RECEIPT

All samples received at the laboratory will be carefully checked for label identification and complete and accurate COC documentation. The condition of the samples will be checked, and the temperature blank will be measured using a calibrated digital thermometer immediately after the cooler is opened. These results and any questions or comments regarding sample integrity will be recorded on the COC form or the appropriate laboratory cooler receipt form. The laboratory will contact Farallon immediately if discrepancies between the samples and COC records are found upon receipt. If it is necessary for the receiving laboratory to ship samples to another laboratory, a COC form will be completed and will accompany the samples. A copy of the COC form and the cooler receipt form will be e-mailed to Farallon within 2 days of sample receipt, and will be included in the final analytical data report.

Once received at the laboratory, the samples will be maintained at 4 ± 2 degrees Celsius (°C), unless it is required that the samples be held at a lower temperature (-10 ± 10°C) to extend the holding time.

If a sample container is received broken, a sample is received in an inappropriate container, or a sample has not been preserved by appropriate means, the laboratory will notify Farallon as soon as possible on the day of sample receipt. The laboratory sample custodian will be responsible for logging the samples in, assigning a unique laboratory identification number to each sample, labeling each sample bottle with its laboratory identification number, and moving the samples to appropriate storage locations to await analysis. The project name, field sample code, date sampled, date received, analysis required, storage location and date, and action for final disposition will be recorded in the laboratory tracking system. Relevant custody documentation will be placed in the project file.

10.0 ANALYTICAL METHODS

Sampling will be performed in accordance with the methods presented in OMMP Addendum No. 1. Groundwater and stormwater samples submitted for analysis will be analyzed for total PCBs and metals. Analyte lists, analytical methods, and target reporting limits are outlined in Table 5 of OMMP Addendum No. 1.

The laboratory standard operating procedures (SOPs) provided by the contracted analytical laboratory will describe the laboratory analytical procedures in detail. These SOPs will be maintained in the analytical laboratory's file.

The laboratory will provide Level IV data reports for all data, to complete the required level of validation.

10.1 REPORTING LIMITS

Reporting limit goals for groundwater and stormwater generally are based on the lowest calibration points. Interferences in individual water samples may result in increased reporting limits. To achieve the required low reporting limits, some modifications to the methods may be necessary. These modifications from EPA 6010B/6020, 1631 E, and 8082 methodology protocols will be provided by the laboratory at the time of sample submittal; any modifications to the methods will be documented in the case narrative that accompanies the final report.

11.0 QUALITY CONTROL

This section describes the field and analytical laboratory QC procedures that will be followed to ensure that data are of known and acceptable precision and accuracy to achieve project objectives.

11.1 FIELD QUALITY CONTROL CHECKS

Field QC samples include field equipment blanks and field duplicates that will be analyzed to identify possible problems resulting from sample collection or sample processing in the field. All field QC samples will be documented in the field logbook, and verified by the Farallon QA/QC Manager or designee.

11.1.1 Field Equipment Blanks

Field equipment blanks will be used to determine whether cross-contamination has occurred during sampling. For stormwater samples, a minimum of one rinsate blank of the water sampling device will be submitted during the project. For groundwater samples, a minimum of one equipment blank of the water level measuring device will be submitted during each groundwater monitoring event.

11.1.2 Field Duplicates

A minimum of one field duplicate will be collected per three samples submitted for analysis for each medium, and evaluated as described in Section 8, Sampling Methods.

11.2 ANALYTICAL LABORATORY QUALITY CONTROL CHECKS

Internal laboratory QC checks will be used to monitor data integrity. These checks will include method blanks, MSs, MSDs, LCSs, LCSDs, internal standards, surrogate standards, calibration standards, and reference material standards. Project-required control limits will be used to evaluate MS, MSD, LCS, and LCSD percent recoveries and RPD values. Surrogate recoveries will be evaluated using laboratory control limits. Laboratory control charts will be used to determine long-term instrument trends.

Results of QC samples from each sample group will be reviewed by the laboratory immediately after a sample group has been analyzed. The QC sample results will then be evaluated to determine whether control limits have been exceeded. If control limits are grossly exceeded in the sample group, the Farallon QA/QC Manager will be contacted immediately, and corrective action (e.g., method modifications followed by reprocessing of the affected samples) will be initiated before a subsequent group of samples is processed.

The primary chemical standards and standard solutions used in this project will be traceable to the National Institute of Standards and Technology, Environmental Resource Associates, National Research Council of Canada, or other documented, reliable commercial sources.

Standards will be validated to determine their accuracy by comparison with an independent standard. Any impurities found in a standard will be documented.

11.2.1 Method Blanks

Method blanks are analyzed to assess possible laboratory contamination at all stages of sample preparation and analysis. The method blank for all analyses must be less than the method reporting limit of any single target analyte or compound. If a laboratory method blank exceeds this criterion for any analyte or compound and the concentration of the analyte or compound in any of the samples is less than 5 times the concentration found in the blank (10 times for common contaminants), analysis must stop, and the source of contamination must be eliminated or reduced.

11.2.2 Laboratory Control Samples

LCSs are prepared and analyzed to assess possible laboratory bias at all stages of sample preparation and analysis. The LCS is a matrix-dependent spiked sample prepared at the time of sample preparation along with the preparation of samples, method blanks, and MSs. The LCS will provide information on the accuracy of the analytical process and, when analyzed in duplicate, will also provide precision information.

11.2.3 Matrix Spikes and Matrix Spike Duplicates

MSs and MSDs will be performed on project-specific samples at a frequency of 5 percent, or one per analytical batch, whichever is more frequent. Analysis of MS samples provides information on the preparation and/or analytical efficiency of the method for the sample matrix. By performing duplicate MS analyses, information on the precision of the method also is provided. MSs and/or laboratory duplicates can be performed in place of MSs and MSDs for inorganic analyses for precision information.

11.2.4 Surrogate Spikes

Surrogates are compounds that are unlikely to occur under natural conditions and have properties similar to the analytes of interest. Surrogates are added to the samples prior to purging or extraction and are used primarily for organic samples analyzed by gas chromatography and/or mass spectrometry methods. The surrogate spike provides broader insight into the proficiency and efficiency of an analytical method on a sample-specific basis. This control reflects analytical conditions that may not be attributable to the sample matrix. The project samples and associated sample QC to be analyzed by organic methods will be spiked with appropriate surrogate compounds as defined in the analytical methods.

11.2.5 Laboratory Duplicates

For inorganic analyses, laboratory duplicates will be analyzed to assess laboratory precision. A laboratory duplicate is defined as a separate aliquot of a sample that is analyzed as a separate sample.

11.2.6 Calibration Standards

Calibration check standards analyzed within a particular analytical series provide information regarding instrument stability, and the validity of instrument calibration. The analytical frequency of calibration check standards is specified by the analytical method.

11.2.7 Standard Reference Materials

Standard reference materials are substances of a matrix that are the same as or similar to those of the project samples and contain a known concentration of the target analyte(s). These materials are prepared and analyzed in the same manner as routine samples and in the same preparation and analytical batch. The recovery of the target analyte(s) provides information on interferences caused by the sample matrix.

12.0 INSTRUMENT AND EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE

Instruments and equipment will be tested and inspected before each sampling event and each laboratory analysis. Any field equipment that is faulty or not functioning properly will not be used for sampling.

Preventive maintenance of laboratory equipment generally will follow the guidelines recommended by the manufacturer. A malfunctioning instrument will be repaired immediately by in-house staff or through a service call to the manufacturer. An instrument malfunction that may impact the project's turnaround time will be communicated to the Farallon QA/QC Manager as soon as the malfunction is discovered so contingencies for analysis can be coordinated.

Maintenance schedules for laboratory equipment will adhere to manufacturer recommendations. Maintenance records will reflect the complete history of each instrument and specify the time frame for future maintenance. Major repairs or maintenance procedures will be performed through service contracts with manufacturers or by qualified contractors. Paperwork associated with service calls and preventive maintenance calls will be kept on file by the laboratory.

Laboratory systems managers are responsible for the routine maintenance of instruments used in a particular laboratory. Any routine preventive maintenance carried out is logged in appropriate logbooks. Routine and non-routine maintenance schedules and procedures will be performed in accordance with the laboratory's QA Plan (Attachment 1).

All major instruments will be backed up by equivalent or comparable instrument systems in the event of unscheduled downtime. An inventory of spare parts will be available to minimize equipment and instrument downtime.

13.0 INSTRUMENT AND EQUIPMENT CALIBRATION PROCEDURES AND FREQUENCY

When analyses are conducted according to EPA methods, the calibration procedures and frequencies specified in the applicable method will be followed. For analyses governed by SOPs, the appropriate laboratory SOP will be used for required calibration procedures and frequencies. Records of calibrations will be filed and maintained by the laboratory. These records may be subject to a QA audit.

The standards used in the calibration of equipment will be directly or indirectly traceable to the National Institute of Standards and Technology, Environmental Resource Associates, National Research Council of Canada, or other documented, reliable commercial sources. The standards received will be logged into standard receipt logs maintained by the individual analytical groups. Each group will maintain a standards log that tracks the preparation of standards used for calibration and QC purposes.

14.0 INSPECTION AND ACCEPTANCE OF SUPPLIES AND CONSUMABLES

Inspection and acceptance of field supplies, including laboratory-prepared sampling bottles, will be conducted by the Farallon Field Coordinator. Primary chemical standards and standard solutions used in this project in either the field or the laboratory will be traceable to documented, reliable commercial sources. Standards will be validated to determine their accuracy by comparison with an independent standard. Any impurities found in the standard will be documented.

15.0 NON-DIRECT MEASUREMENTS

Additional existing project data may be obtained from EMJ or EPA. If such project data are needed, EMJ or EPA will be asked to provide any information on data limitations. These existing project data will be maintained with the project files.

16.0 DATA MANAGEMENT

All data will undergo two levels of QA/QC evaluation: one at the laboratory, and one by a qualified data validator. Initial data reduction, evaluation, and reporting at the laboratory will be carried out as described in the applicable analytical protocols and the laboratory's Quality Assurance Plan QA manual (Attachment 1). QC data resulting from methods and procedures described in this document also will be reported.

16.1 SAMPLE MANAGEMENT

All laboratory analytical batches will be assigned a unique number and tracking identifier at the laboratory. All data reports will include this tracking number. The laboratory will use a laboratory information management system to track all samples throughout the analytical process.

16.2 DATA REPORTING

Laboratory analytical results will be provided by the laboratory in digital and electronic deliverable formats. The data packages will be reviewed to ensure that the correct analyses were performed for each sample submitted, and that all of the analyses requested on the COC form were performed. If discrepancies are noted, the Farallon QA/QC Manager will be notified and will promptly follow up with the laboratory to resolve any issues.

Following completion of data validation, the digital files will be used to generate report tables. Electronic data deliverables (EDDs) will be supplied by the laboratory in Farallon's custom EQuIS electronic format. Laboratory data that are electronically provided and loaded into the database will undergo a 10 percent check against the laboratory data deliverable. Data will be validated or reviewed manually, and qualifiers, if assigned, will be entered manually. All manually entered data will be verified by a second party. Data tables and reports will be exported from EQuIS to Microsoft Excel tables as needed.

Any analytical data that cannot be provided by the laboratory in electronic format will be entered manually. After entry into the database, EDD data will be compared to the field information previously entered into the database to confirm that all requested analytical data have been received.

16.3 DATA MANAGEMENT PROCEDURES

A record of field documentation and analytical and QA/QC results will be maintained to ensure the validity of the data. Carefully constructed sample tracking and data management procedures will be used throughout the sampling program to effectively execute such documentation.

Sample tracking will begin with completion of COC forms, as described in the Field Sampling Plan (Attachment 2 of the Sampling and Analysis Plan; Appendix I of the BODR), and summarized in Section 8, Sampling Methods. Copies of completed COC forms will be maintained in the project files. The laboratory will verify receipt of the samples electronically within 48 hours of sample receipt.

When analytical data are received from the laboratory, the Farallon QA/QC Manager will review incoming analytical data packages and compare the information to the COCs to confirm that the correct analyses were performed for each sample, and that results were received for all samples submitted for analysis. Any discrepancies noted will be promptly followed up by the Farallon QA/QC Manager.

16.4 LABORATORY TURNAROUND TIME

The laboratory turnaround time for data is 3 weeks from sample receipt to submission of the finalized data report. Preliminary water quality COC data will be requested within 48 to 72 hours of sample receipt.

17.0 ASSESSMENTS AND RESPONSE ACTIONS

Project activities will be assessed during implementation using laboratory and field performance audits, if deemed necessary by the Farallon Field Coordinator or the Farallon and/or EPA QA/QC Managers. The audits and corrective action procedures are discussed below.

17.1 LABORATORY AND FIELD PERFORMANCE AUDITS

Laboratory and field performance audits consist of on-site reviews of QA/QC systems and equipment for sampling, calibration, and measurement. Laboratory audits will be conducted for this project, if deemed necessary by the QA/QC Managers. All laboratory audit reports will be made available to the Farallon QA/QC Manager upon request. All laboratories are required to have written procedures addressing internal QA/QC, which will be submitted to and reviewed by the Farallon QA/QC Manager to ensure compliance with the QAPP. All laboratories must ensure that personnel engaged in sampling and analysis tasks have appropriate training.

As part of the audit process, the laboratory will provide written details of any planned modifications to laboratory protocols for review and approval by EPA and Farallon.

17.2 CORRECTIVE ACTION PROCEDURES

The following sections describe corrective action procedures for field and laboratory procedures.

17.2.1 Corrective Action for Field Sampling

The Farallon Field Coordinator will be responsible for correcting equipment malfunctions during the field sampling effort. The Farallon QA/QC Manager will be responsible for resolving situations in the field that may result in noncompliance with the QAPP. All corrective measures will be immediately documented in the field logbook.

17.2.2 Corrective Action for Laboratory Analyses

The laboratory is required to comply with its SOPs, and submit copies of its SOPs to the QAPP distribution list presented in Section 2.6. The Laboratory Project Manager will be responsible for ensuring that appropriate corrective actions are initiated as required for compliance with the QAPP. All laboratory personnel will be responsible for reporting problems that may compromise data quality.

If QC results exceed laboratory control limits, the analyst will identify and correct the anomaly before continuing with sample analyses, if possible. If the QC exceedance cannot be overcome with standard corrective action (e.g., re-preparation and/or re-analysis), the cause(s) of the exceedance and the steps taken to overcome it will be discussed by the laboratory Project Manager in the data package narrative. If the exceedance is gross or widespread, the Farallon QA/QC Manager will be notified immediately, and the appropriate corrective action will be determined.

18.0 DATA REVIEW, VERIFICATION, AND VALIDATION

Once the data have been received from the laboratory, a number of QC procedures will be followed to accurately evaluate data quality and assess data precision, accuracy, and completeness.

18.1 DATA QUALITY CONTROL REVIEW

Chemistry data will be subject to multilevel review by the selected analytical laboratory. The group leader will review data reports prior to their release for final data report generation. The Laboratory QA Manager will review the final data reports, and the Laboratory Project Manager will review a cross-section of the final data reports prior to delivery to Farallon.

If discrepancies or deficiencies are identified in the analytical results, corrective action will be taken, as discussed in Section 17.2.2, Corrective Action for Laboratory Analyses.

18.2 DATA VERIFICATION AND VALIDATION

Data reports will be reviewed and verified by the Farallon QA/QC Manager to ensure that all analyses were completed and all analytes of interest were reported. Any problems will be discussed with the laboratory to correct errors. Data validation will be performed under the guidance of EPA (1999, 2004, 2005, 2008) National Functional Guidelines and in accordance with the QAPP within 14 days of review and verification of the data reports by the Farallon QA/QC Manager.

19.0 VERIFICATION AND VALIDATION METHODS

All laboratory data will undergo Stage 2B data validation (EPA 2009). Data validation will be performed under the guidance of EPA (1999, 2004, 2005, 2008) National Functional Guidelines and in accordance with the QAPP. The following will be reviewed, as appropriate to the level of data validation being performed, and as applicable to the analysis:

- COC forms;
- Holding times;
- Instrument tunes and calibration;
- Method blanks;
- Surrogate recoveries;
- MS and MSD recoveries and RPD values;
- LCS and LCSD recoveries and RPD values;
- Field duplicate RPD values;
- Laboratory duplicate RPD values; and
- Detection and reporting limits.

The results of the data quality review, including text assigning qualifiers in accordance with EPA National Functional Guidelines and a tabular summary of qualifiers, will be generated by the data validator and submitted to the Farallon QA/QC Manager for final review and confirmation of the validity of the data. Copies of the validation reports will be submitted and presented as an appendix to the applicable data reports.

20.0 RECONCILIATION WITH USER REQUIREMENTS

The Farallon QA/QC Manager will review data to determine whether DQOs have been met. If data do not meet the project's specifications, the Farallon QA/QC Manager will review the errors and determine whether the problem is due to calibration and/or maintenance, sampling techniques, or other factors. Corrective action will be discussed with the laboratory and implemented as necessary. If corrective action does not correct the problem, the DQOs will be reviewed for feasibility. If specific DQOs are not achievable, the Farallon QA/QC Manager will recommend appropriate modifications. Any revision will require EPA approval.

21.0 REPORTING

Reporting requirements are described in detail in OMMP Addendum No. 1. Reports or reporting requirements generally will occur as described below.

Groundwater and stormwater monitoring reports will be incorporated into the OMMP monitoring report following Year 1 and Year 3 monitoring events. Following the Year 2 monitoring event, a standalone Year 2 OMMP monitoring report summarizing only groundwater and stormwater monitoring results will be prepared. Each monitoring report will be prepared and submitted to EPA within 90 days of receipt of final validated analytical results for that event. The reports will include a description and evaluation of the monitoring activities conducted during the monitoring period.

22.0 REFERENCES

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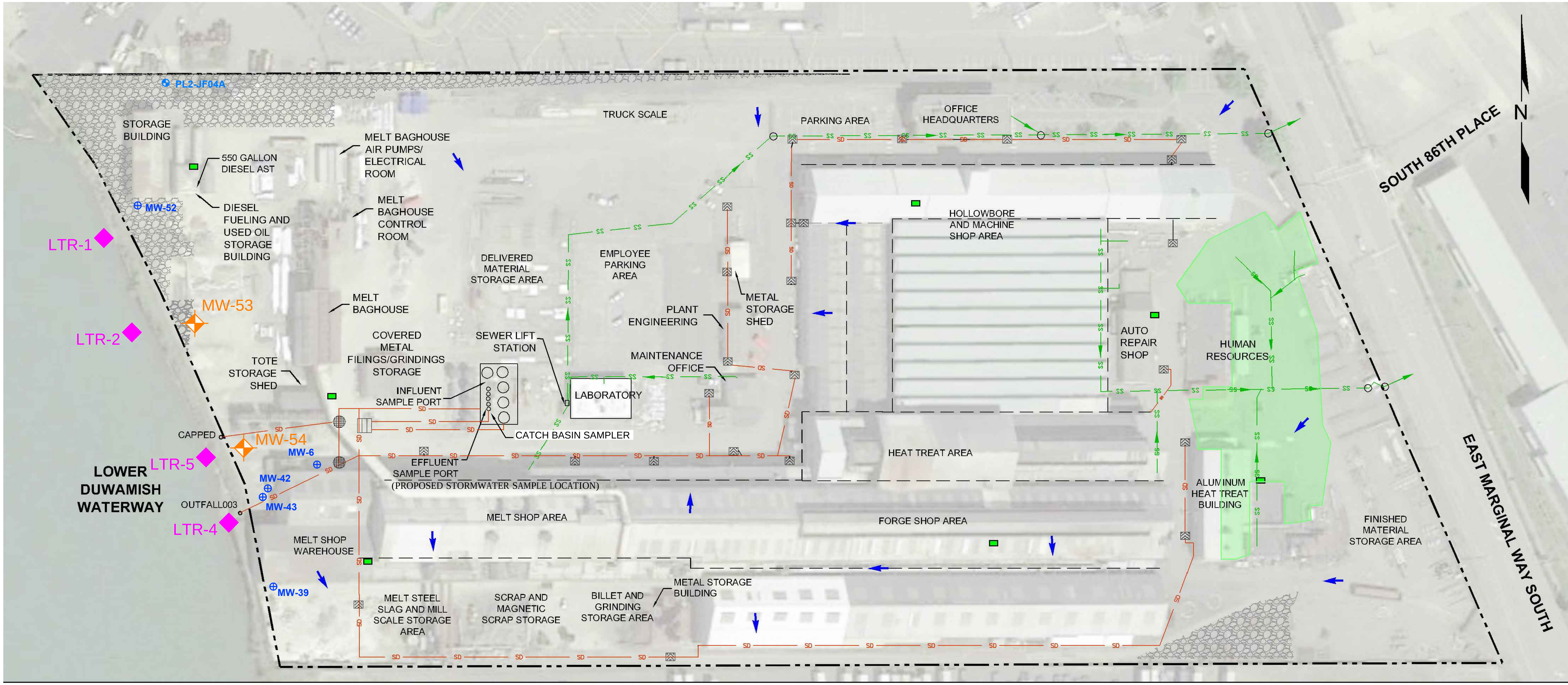
FIGURE

QUALITY ASSURANCE PROJECT PLAN
APPENDIX D OF ADDENDUM NO. 1 TO THE OPERATIONS, MONITORING, AND MAINTENANCE PLAN, BASIS OF DESIGN REPORT
Jorgensen Forge Early Action Area Removal Action
Seattle, Washington

Farallon PN: 831-032



LEGEND

PROPERTY BOUNDARY

STORMWATER PIPE

ROOF CONVEYANCE

SANITARY SEWER PIPE AND FLOW DIRECTION

GRAVEL SURFACE (PERVIOUS)

SANITARY SEWER DRAINAGE AREA

STORMWATER FLOW ARROW

SPILL KIT LOCATION

STORMWATER COLLECTION VAULT

CATCH BASIN

MANHOLE

MW-39 MONITORING WELL

PL2-JF04A BOEING MONITORING WELL

PROPOSED MONITORING WELL

PROPOSED SURFACE SEDIMENT SAMPLING LOCATION

0 110
Scale in feet

NOTE:
STRUCTURES AND FEATURES SHOWN ON THIS FIGURE WERE NOT VERIFIED BY SURVEY BY SOUNDEARTH STRATEGIES INC. LOCATIONAL INFORMATION HAS BEEN ADAPTED FROM APPENDIX C OF THE ENGINEERING REPORT DRAFTED BY ANCHOR QEA, LLC.

FIGURE PROVIDED BY SOUND EARTH STRATEGIES DATED APRIL 08, 2014

FARALLON CONSULTING
Quality Service for Environmental Solutions | farallonconsulting.com

Washington
Issaquah | Bellingham | Seattle
Oregon
Portland
California
Oakland | Sacramento

FIGURE 1

PROPOSED GROUNDWATER AND STORMWATER COMPLIANCE SAMPLING LOCATIONS
BASIS OF DESIGN REPORT OPERATIONS, MONITORING, AND MAINTENANCE PLAN ADDENDUM
JORGENSEN FORGE EAA REMOVAL ACTION

FARALLON PN: 831-032

Drawn By: DEW | Checked By: AED | Date: 5/8/2015 | Disk Reference: 831032

TABLES

QUALITY ASSURANCE PROJECT PLAN
APPENDIX D OF ADDENDUM NO. 1 TO THE OPERATIONS, MONITORING, AND MAINTENANCE PLAN, BASIS OF DESIGN REPORT
Jorgensen Forge Early Action Area Removal Action
Seattle, Washington

Farallon PN: 831-032

Appendix D--QAPP Table 1
Quantitative Goals for Groundwater, Stormwater, Catch Basin Solids, and Soil Analytical Data
Jorgensen Forge EAA Removal Action
Seattle, Washington
Farallon PN: 831-032

Parameter	Precision (duplicates)	Recovery Goals[1]	Completeness
Groundwater			
Total and Dissolved Metals	± 35% RPD	75-125% R	95%
PCBs	± 35% RPD	62-120% R	95%
Stormwater			
Total and Dissolved Metals	± 35% RPD	75-125% R	95%
PCBs	± 35% RPD	62-120% R	95%
Solids			
Total and Dissolved Metals	± 20%	75-125%	95%
PCBs	± 30%	51-120%	95%
TOC	± 20%	75-125%	95%
Soil			
Total and Dissolved Metals	± 20%	75-125%	95%
PCBs	± 30%	62-120%	95%

NOTES:

[1]Percent recovery goals apply to laboratory control sample/laboratory control sample duplicate and matrix spike/matrix spike duplicate analyses

EAA = Early Action Area
PCB = polychlorinated biphenyl
R = Recovery
RPD = Relative percent difference
TOC = total organic carbon

Appendix D--QAPP Table 2
Laboratory Quality Control Sample Analysis Frequency
Jorgensen Forge EAA Removal Action
Seattle, Washington
Farallon PN: 831-032

Analysis Type	Initial Calibration	Ongoing Calibration	Replicates	Matrix Spikes	LCS/SRM[1]	Matrix Spike Duplicates	Method Blanks	Surrogate Spikes
Metals	Daily	1 per 10 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	NA	1 per 20 samples	NA
PCBs	As needed[1]	1 per 10 samples	NA	1 per 20 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	Every sample

NOTES:

[1]Initial calibrations are considered valid until the ongoing continuing calibration no longer meets method specifications. At that point, a new initial calibration is performed.

EAA = Early Action Area
LCS = laboratory control sample
NA = not applicable
PCB = polychlorinated biphenyl
SRM = standard reference material

Appendix D--QAPP Table 3
Special Personnel Training and Certifications
Jorgensen Forge EAA Removal Action
Seattle, Washington
Farallon PN: 831-032

Specialized Training Course Title or Description	Training Provider	Training Date	Personnel Receiving Training/ Organizational Affiliation: Personnel Project Responsibilities	Personnel Receiving Training/ Organizational Affiliation: Personnel Name	Location of Records & Certificates
40-Hour HAZWOPER training	Western States Environmental, Inc.	3/6/2009	Farallon Field Coordinator/Data Manager	Emerald Erickson-Mulanax/Farallon Consulting, L.L.C.	Farallon Consulting, L.L.C.
8-Hour HAZWOPER Refresher Training	Farallon Consulting, L.L.C.	2/2/2015			
8-Hour Supervisor Training	RGA Environmental, Inc.	11/24/2009			
Licensed Geologist (L.G.)	Washington State Department of Licensing	4/26/2013			
Fundamentals of Contaminant Chemistry	Northwest Environmental Training Center	4/26/2010			
40-Hour HAZWOPER training	National Environmental Trainers, Inc.	5/9/2013	Farallon Field Personnel - Well Installation, Groundwater Sampling	Ryan Ostrom/Farallon Consulting, L.L.C.	
8-Hour Refresher Training	Farallon Consulting, L.L.C.	2/2/2015			
Principles of Contaminant Transport	Northwest Environmental Training Center	1/16/2015			
EPA Method 1669 training	Farallon Consulting, L.L.C.	To Be Conducted Before Sampling			
40-Hour HAZWOPER training	ARGUS Pacific	10/13/2012	Farallon Field Personnel - Groundwater and Stormwater Sampling	Anna Sigel/Farallon Consulting, L.L.C.	
8-Hour Refresher Training	Farallon Consulting, L.L.C.	2/2/2015			
Industrial stormwater management training	Environmental Coalition of South Seattle	3/8/2013			
EPA Method 1669 training	Farallon Consulting, L.L.C.	To Be Conducted Before Sampling			
8-Hour Supervisor Training	Prezant Associates, Inc.	4/29/1999	Farallon Project Manager	Amy Essig Desai/Farallon Consulting, L.L.C.	
Industrial stormwater management training	Environmental Coalition of South Seattle	3/8/2013	Farallon QA/QC Manger	Gerald J. Portele/Farallon Consulting, L.L.C.	
26 years of experience in data validation and quality assurance	NA	NA	Laboratory Project Manager	Christine Ranson/ EcoChem	EcoChem
20+ years of experience with data validation packages and data usability determinations.	NA	NA	Laboratory Project Manager	Mark Harris/Analytical Resources, Inc.	Analytical Resources, Inc.

NOTES:
EAA = Early Action Area
HAZWOPER = Hazardous Waste Operations and Emergency Response
TBD = To be Determined

Appendix D--QAPP Table 4
Groundwater, Stormwater, Solids, and Soil Sampling Information
Jorgensen Forge EAA Removal Action
Seattle, Washington
Farallon PN: 831-032

Location	Sample Location (Lat/Long)	No. of samples to be collected over 3 years	Matrix	Parameters to be analyzed for each sample	Sample Size	Container Size and Type	Holding Time	Sample Preservation Technique	LOQ
SW System Effluent Port	N: 195426.94 E: 1276288.86 (approximate)	2 to 12 (2 total, up to 4 annually)	Solids	Metals	1 oz.	25 liter plastic container filtered with 5 micron filter by laboratory	6 months	Cool/4°C	5.0 mg/kg wet weight (except Mercury is 0.025 mg/kg-wet weight)
				PCBs	2 oz.	25 liter plastic container filtered with 5 micron filter by laboratory	14 days	Cool/4°C	0.02 mg/kg wet weight
				TOC	1 oz.	25 liter plastic container filtered with 5 micron filter by laboratory	14 days	Cool/4°C	200 mg/kg
		6 to 12 (2 to 4 annually)	Stormwater	Metals, dissolved	500 ml	500 ml HDPE	6 months	HNO_3 to pH < 2	0.01 µg/l (except Mercury is 0.0004)
				Metals, total	500 ml	500 ml HDPE	28 days	HNO_3 to pH < 3	
				PCBs	1,000 ml	1 x 1,000 ml amber glass	7 days until extraction	Cool/4°C	0.01 µg/l
							40 days after extraction (hexane solvent used for extraction)	Cool/4°C	
MW-52	N: 195659.56 E: 1275893.45	3 (1 annually)	Groundwater	Metals, dissolved	500 ml	500 ml HDPE	6 months	HNO_3 to pH < 2	0.01 µg/l (except Mercury is 0.0004)
				Metals, total	500 ml	500 ml HDPE	28 days	HNO_3 to pH < 3	
MW-53	N: 195524.78 E: 1275958.29 (tentative)			PCBs	1,000 ml	1 x 1,000 ml amber glass	7 days until extraction	Cool/4°C	0.01 µg/l
MW-54	N: 195384.06 E: 1276013.20 (tentative)						40 days after extraction (hexane solvent used for extraction)	Cool/4°C	
		Approx. 6 (one-time event)	Soil	Metals	4 oz.	4 oz. glass jar	6 months	Cool/4°C	5.0 mg/kg wet weight (except Mercury is 0.025 mg/kg-wet weight)
				PCBs	8 oz.	8 oz. glass jar	14 days	Cool/4°C	0.02 mg/kg wet weight

NOTES:

°C = degrees Celsius
µg/l = micrograms per liter
E =easting in North American Datum 1983
EAA = Early Action Area
HDPE = high-density polyethylene
HNO_3 = nitric acid
LOQ = limit of detection
ml = milliliter
mg/kg = milligrams/kilogram
N = northing in North American Datum 1983
oz = ounce
PCBs = polychlorinated biphenyls
TOC = total organic carbon

ATTACHMENT 1
ANALYTICAL RESOURCES, INC.
QUALITY ASSURANCE PLAN

QUALITY ASSURANCE PROJECT PLAN
APPENDIX D OF ADDENDUM NO. 1 TO THE OPERATIONS, MONITORING, AND MAINTENANCE PLAN, BASIS OF DESIGN REPORT
Jorgensen Forge Early Action Area Removal Action
Seattle, Washington

Farallon PN: 831-032

Analytical Resources Inc. Quality Assurance Plan

Analytical Resources, Incorporated
Analytical Chemists and Consultants

Quality Assurance Plan

Analytical Resources, Inc.
4611 S. 134th Place, Suite 100
Tukwila, WA 98168-3240

Revision 014-001
4/2/12

Uncontrolled Copy

A web page is configured to inform you if this is the most recent version of ARI's LQAP. Click on the link or type the URL into your web browser. No web access? Phone 206-695-6200

http://arilabs.com/cgi-bin/rcheck.cgi?f=LQAP&r=R13000

This Quality Assurance Plan is approved and authorized for release by:

Mark Weidner
Laboratory Technical Director

Brian N. Bebee
Organic Analysis Section Technical Director

Jay Kuhn
Inorganic Analysis Section Technical Director

David Mitchell
Quality Assurance Manager

Analytical Resources, Incorporated
Analytical Chemists and Consultants

Quality Assurance Plan

Analytical Resources Inc.

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Analytical Resources, Incorporated
Analytical Chemists and Consultants

SECTION 1: INTRODUCTION

Quality Assurance Policy and Objectives

Analytical Resources, Inc. (ARI) is dedicated to providing accurate and reliable data in a timely and cost effective manner. The management of ARI is committed to analytical excellence and continual improvement of the laboratory's quality system. Management will demonstrate this commitment by providing all required resources and promoting a corporate culture based on meeting client requirements, operating in accordance with legal and regulatory requirements in accordance with ARI's established ethics policy.

The quality assurance program detailed in this document sets forth the policies and procedures that are followed by ARI to ensure that all reported results are both legally defensible and of the highest quality.

To ensure that data quality goals are achieved, the following characteristics must be considered:

Precision, Bias and Accuracy

For all analyses, there is a degree of uncertainty or error in the measurement process. This measurement error is generally one of two types: random error (precision) or systematic error (bias). Precision is a measure of agreement between replicate measurements. Bias is considered to be the difference between the expected value and the true value for a measurement or series of measurements. Accuracy is a determination of how closely a measurement is to the expected value. Both precision and bias are considered when determining the accuracy of measurements. Precision, bias and accuracy are evaluated through the use of method guidelines, and project and laboratory control limits.

Representativeness

Representativeness is an indicator of how closely one sample aliquot resembles another aliquot from the same bulk source or sample site. Sample representativeness is more easily obtained for particulate-free water samples than for solid samples or viscous liquids. Representativeness is an important consideration in achieving other data quality objectives.

Completeness

Completeness is an indicator of the number of valid (useable) data points compared with the overall number of data points obtained. Valid data are normally obtained when sample collection and analysis is performed in accordance with specified methods and procedures. Completeness is often expressed as a percentage: the higher the number of valid data points, the higher the overall completeness percentage. Conversely, fewer valid data points will result in an overall lower percentage of completeness. Project specifications will dictate the required level of completeness.

Comparability

Comparability is an indicator of how confidently one data set can be compared with another, as well as the consistency between data sets. Stable analytical conditions and adherence to standard procedures, combined with high levels of accuracy; help ensure that results obtained over a period of time will be comparable.

Timeliness

To ensure that the most accurate results possible are obtained, samples must be processed within specified time periods. Analytical holding times have been established to allow sufficient time for sample processing without compromising sample integrity. It is important that, while meeting timeliness requirements, other data quality objectives are still considered and met.

Documentation

Complete and accurate documentation is essential for verifying the integrity of analytical results. Achievement of other quality objectives cannot be used to substantiate data quality without full documentation of the analytical process. Documentation must be concise and readily available for subsequent review.

The quality assurance program at ARI has been developed to ensure that the specified data quality objectives are met for all reported results and the highest degree of completeness possible is achieved.

1.2 Ethics Policy on Data Quality and Confidentiality

To ensure that data quality or confidentiality is not compromised, ARI has established the following policy on corporate ethics. These steps must be taken when the quality or confidentiality of data is suspected or known to be compromised. This policy applies to all ARI employees at every organizational level.

General

ARI's corporate commitment to integrity and honesty in the workplace is clearly stated in the ARI Employee's Handbook, under "Standards of Conduct". The Standards of Conduct statement is attached as Appendix O. The ARI commitment to excellence in data quality extends to and includes all aspects of data production, review and reporting.

Any attempt by management or any employee to compromise this commitment presents a case for serious disciplinary action. Any indications or allegations of waste, fraud or abuse will be rigorously investigated by ARI management, with the penalties for verified cases to be employment termination, and if appropriate, prosecution. In addition to these steps, any such charges related to data generated for the federal government will also be reported to the Inspector General of the appropriate department.

Circumstances

All ARI employees will immediately report to management any information concerning the misrepresentation or possible misrepresentation of analytical data (or any associated components).

Misrepresentation of data includes (but is not limited to) the following:

Altering an instrument, computer or clock to falsify time or output
Altering the content of a logbook or data sheet in order to misrepresent data
Falsifying analyst identity
Changing documents with correction fluid with the intent of falsifying information
Preparing or submitting counterfeit data packages or reports
Unauthorized release (either written or verbal) of confidential data
Illegal calibration techniques (peak shaving, fraudulent integrator parameters)
Any attempt to misrepresent data or events as they actually occur in the course of data production or reporting

Responsibilities

It is the responsibility of all ARI employees to report any situation which may be adverse to data quality or confidentiality, or which may impact the final data quality. All ARI employees have the obligation to discuss known or suspected violations of this policy with laboratory management, who in turn are obliged to inform the ARI Laboratory Manager. If a satisfactory resolution is not obtained or is not possible at laboratory level, all ARI employees have the right and responsibility to discuss the matter directly with the ARI Laboratory Manager.

It is the responsibility of the ARI Laboratory Manager to promptly investigate any reports of known or suspected violations. The ARI Laboratory Manager has the authority and responsibility to resolve all known or potential violations of the policy.

It is the responsibility of ARI management to provide all of its employees with the facilities, equipment, and training to achieve the quality goals stated in the policy. It is the responsibility of ARI to provide our clients with data of known and documented quality.

Documentation

To reaffirm an awareness of and commitment to the highest standards of data quality, excellence, and integrity, all employees are required to sign the following “Commitment to Excellence in Data Quality” statement:

“As an ARI employee, I have the right and responsibility to report any situation which may be adverse to quality or which may impact the final quality or integrity of data produced for our clients.”

“I will report immediately to management any information concerning the misrepresentation or possible misrepresentation of analytical data (or any of its associated components). Examples of this include (but are not limited to): alteration of an instrument computer or clock, alteration of the contents of logbooks and/or data sheets in order to misrepresent data, misrepresentation of analyst identity, intentional falsification of documents with correction fluid (“white-out”), preparation and submittal of counterfeit data packages, use of illegal calibration techniques (peak shaving, use of fraudulent integrator parameters, etc.), or any attempt to misrepresent data or events as they actually occur in the course of an analysis.”

“I will likewise alert management of any situation or activity which may be adverse to the confidentiality of clients’ data.”

“I will not knowingly participate in any such activity, nor fail to report such activities of which I may become aware. I understand that any voluntary participation on my part in such activities may result in the termination of my employment, and possible legal prosecution.”

“Where circumstances permit, I will report any actual or suspected violations of this policy to my lab or section supervisor. If a satisfactory resolution is not obtained or is not possible at that level, I have the right and obligation to discuss the matter directly with the ARI Laboratory Manager.”

Confidentiality

All information related to client projects, such as client work plans, documentation and analytical data will be considered confidential. This information will be released only to the client or an authorized representative. Should an outside agency request information related to a client project, the client will be contacted for approval prior to releasing any information.

Some programs or contractual agreements (such as the USEPA Contract Laboratory Program) may have specific requirements for protecting a client's confidentiality Project Managers will be responsible for strict control of access to any such confidential information or documentation. All data generated from the analysis of confidential samples will also be considered confidential.

SECTION 2.0: QA MANAGEMENT AND RESPONSIBILITIES

Management includes the Laboratory Director, Section Managers, the Customer Service Director, Laboratory Supervisors, and the Quality Manager Receiving Manager. Roles and responsibilities are defined in Section 2.2 below.

Management's commitment to good professional practice and to the quality of its products is defined in Section1.0. In addition, management has overall responsibility for the technical operations and the authority needed to generate the required quality of laboratory operations. Management ensures communication within the organization to maintain an effective management system and to communicate the importance of meeting customer, statutory, and regulatory requirements. Management assures that the system documentation is known and available so that appropriate personnel can implement their part. When changes to the management system occur or are planned, managers ensure that the integrity of the system is maintained.

Management is responsible for carrying out testing activities that meet the requirements of the TNI Standard, the ISO/IEC 17025 Standard, the DoD-QSM and that meet the needs of the client.

The principal tenet of the Quality Assurance Program at Analytical Resources Inc. (ARI) is that every employee knows she/he is a vital component of the program, and holds a responsibility to produce high-quality, defensible data in a timely manner. While production of quality data is a global philosophy, held by the entire laboratory, each section is responsible for ensuring that the data produced within that section meets the required quality objectives.

2.1 Overall Structure

The Board of Directors shall direct ARI's QA Policy and shall determine the Philosophy of the QA Program. It shall be the responsibility of the Laboratory Director to translate this policy into practical procedures with respect to the business plan developed for ARI, and direct the Laboratory Manager and Section Managers regarding the incorporation of these procedures into daily laboratory activities.

The Laboratory Manager is responsible for coordination of laboratory activities to result in an integrated approach to quality data production. The Laboratory Manager will coordinate Client Services, Laboratory Section Management, Computer Services, and Data Services to ensure that project requirements and data quality objectives are met.

The Laboratory Section Managers and Supervisors shall hold the final authority in decisions concerning implementation of QA policy, with the contributions of the Laboratory Director, Laboratory Manager, QA Manager and Project Managers. Section Managers and Section Supervisors shall instruct employees in the proper employment of QA policies.

Each Section Supervisor will ensure that analyses are completed within required holding times, that data is submitted within required submission times, and all analyses are performed according to the current Standard Operating Procedures (SOPs). They will ensure that any client modifications or QA issues are well documented for each sample set and that all required documents are complete when submitted with each data set.

The analytical staff shall execute all methods following QA policies, and will write SOPs reflecting the methods exactly as performed. These SOPs will be reviewed for compliance by Section Managers and the Laboratory Director, and once approved will be submitted to the Quality Assurance Program Manager (QAPM).

The QAPM will be responsible for controlling Company SOPs and other internal documents, overseeing the scheduling and completion of detection limit studies. The QAPM will coordinate the production of control charts and distribution of control limit data to all laboratory sections. The QAPM will administer the blind QA proficiency tests and performance samples as described in the QA Program. The QAPM will verify that QA policies and procedures are followed through out ARI.

Data reviewers will be responsible for ensuring that all samples have been analyzed by the approved and requested methods, that data calculations are performed correctly, and that analyses meet the Data Quality Objectives of the client. They shall also be responsible for ensuring that the documentation from each laboratory section is intact and complete.

Computer Services is responsible for ensuring that the Laboratory Information Management System (LIMS) correctly reflects the preparations and analyses performed and that the LIMS is updated with the current SOP, MDL, RL and QL data as submitted from the QAPM. Computer Services personnel are also responsible for ensuring that all electronic deliverables for clients are formatted correctly as requested by the Project Managers and that this data matches the hardcopy deliverables submitted.

Client Services (Project Management, Sample Receiving), shall be responsible for ensuring that the laboratories understand and can meet project specific analytical requirements and DQO.

2.2 Hierarchical Responsibilities

Technical Director

> *It shall be the responsibility of the Laboratory Director to translate QA policy into practical procedures with respect to ARI's business plan, and to direct the Laboratory Manager and Section Managers in the implementation of these procedures in daily laboratory activities.*

The Director shall interpret overall QA Policy based on the requirements of the TNI Standard, the ISO/IEC 17025 Standard, the DoD-QSM and determine the broad practicality of policies based on methodologies, technological advances, and the current environmental market. It shall be the interpretation of these policies that will, in turn, direct the growth ARI, the addition or withdrawal of methods to ARI's repertoire, and ARI's marketing focus.

At a minimum of once a year the Technical Director shall include on the agenda of the Board of Directors meeting a discussion of ARI's QA Policy. This discussion will include the reputation of ARI for producing quality analyses, the affect of QA policies on turn-around time, competitive edge and cost-of-analysis, needs for stricter or more flexible policies, and the response of employees to the QA policies in place at that time.

At a minimum of once every six months the Director shall attend management meetings, which include on the agenda the subject 'QA Program'. This format will allow for the dissemination of information on any QA issues addressed in the laboratory or by the Board of Directors. Management shall also use these meetings to discuss requirements of clients that are not met by ARI's present QA Program, and the appropriate response to these requirements.

The Technical Director may be required to act as a technical advisor at any impromptu meetings called by management to address QA issues that cannot be immediately resolved within a laboratory section.

It shall also be the Director's authority and responsibility to hold final review approval for all SOPs of ARI. Once an SOP has been updated and reviewed by the laboratory section, it shall go through the Section and Laboratory Managers for approval, and then to the Laboratory Director for final approval before the SOP is released.

Laboratory Manager

> *The Laboratory Manager is responsible for coordination of laboratory activities to result in an integrated approach to quality data production. It shall be the Laboratory Manager's responsibility to coordinate Client Services, Laboratory Management, Computer Services, and Data Services to ensure that QA Program requirements and data quality objectives are met.*

The Laboratory Manager is required to attend all management meetings, at which the QA Program will be an agenda item. Management shall use these meetings to discuss requirements of clients that are not met by ARI′s present QA Program, the appropriate response to these requirements, and dissemination of information on any QA issues addressed in the laboratory or by the Board of Directors.

It is the responsibility of the Laboratory Manager, along with the QA Manager, Laboratory Director, Section Managers and Client Services, to establish testing activities that meet the requirements of the TNI Standard, the ISO/IEC 17025 Standard, the DoD-QSM and that meet the needs of the client.

The Laboratory Manager has the authority to direct Client Services to discontinue the bidding/contracting process for a new project, refuse samples, or to re-schedule projects based on Data Quality Objectives or current workload. The Laboratory Manager also shall evaluate staffing and equipment needs based on information from the Section Managers and Client Services and may elect to meet new project requirements by increasing staffing levels or purchasing additional equipment.

The Laboratory Manager serves as a senior-level technical reference for all laboratory activities, and as such will be brought in to advise on out-of-control events and trends, corrective actions, and/or other QA issues that require his/her expertise.

Laboratory Section Managers

> *The Section Managers shall hold the final authority in decisions concerning implementation of QA policy, with the contributions of the Laboratory Director, Laboratory Manager, QAPM and Project Managers. Section Managers are responsible for correcting out of control events within their respective laboratories. Section Managers and supervisors shall instruct employees in the proper employment of QA Policies.*

Laboratory Sections Managers shall have the final authority in decisions concerning QA policy. It is their expertise that will determine if testing activities meet the requirements of the TNI Standard, the ISO/IEC 17025 Standard, the DoD-QSM the needs of the client.

Laboratory Section Managers are responsible for completing or delegating updates of laboratory procedures and quality assurance manual sections as scheduled by the QA Manager. They will review and approve all laboratory Standard Operation Procedures.

The Section Managers are best able to determine capacity of the Laboratory Sections. To ensure that analyses are completed within required hold times, the Section Managers will give Supervisors the authority to balance employee workloads and modify employee work schedules. It is the Section Manager's responsibility to take reports from supervisors and work with the Laboratory Manager to increase staffing levels or reject samples as needed. It is the Section Manager's responsibility to work with the Laboratory Manager and the section supervisor and analysts to ensure that sample capacity does not affect the quality of data generated from that laboratory section.

It is the responsibility of the Laboratory Section Managers, along with the QA Manager, Laboratory Director, Laboratory Manager and Client Services, to determine in which QA Proficiency Programs the Laboratory will participate, and which accreditation processes ARI will pursue. It is the responsibility of the Section Managers, with the Section Supervisors, to ensure that all laboratory sections perform the tasks required by the QA Manager to pursue each accreditation or to complete a scheduled audit.

The Section Manager will be responsible for reviewing training records of analysts produced by the Section Supervisor. Training shall be the responsibility of the Section Supervisor, but it is the responsibility of the Section Manager to oversee this training.

It is the Section Managers' responsibility to work with the Section Supervisor and Project Manager to assure that Project Requirements are achievable and valid for the given methods. At times, ARI′s clients have requests or requirements for methods that are 1) not the method of choice in the laboratory, 2) not presently performed by the laboratory, or 3) unachievable by the instrumentation used in the laboratory. It is the responsibility of the Section Supervisor, Section Manager and Project Manager to work with the client to resolve these issues before samples are accepted.

Clients may also request modifications to the methods that must be approved by the Section Supervisor, the Section Manager and the QAPM. These modifications must be thoroughly documented and all pertinent information on modifications must be conveyed to the analysts, sample preparation sections, sample receiving, and computer services, as needed for implementation.

The Section Manager is responsible for resolution of out-of-control events that have not or cannot be resolved by the analysts or Section Supervisor.

The Section Manager has the authority to re-classify analysts or require additional training of analysts based on their performance.

The Section Manager has the responsibility of balancing client requests and requirements with the QA policies of ARI. It is the Section Manager's task to evaluate a client's Data Quality Objectives (submitted through Client Services), and with the Project Managers, Laboratory Supervisors and Quality Assurance Manager to determine the feasibility of laboratory performance. Feasibility will be based on the quality objectives requested, current QA Manual, present workload (in-house and scheduled/pending), the technology in place, and staffing levels available. Current workload in-house will be evaluated using reports from Computer Services, and scheduled/pending workload will be evaluated using written and verbal input from Client Services.

Section Supervisors

It is the responsibility of each section Supervisor to ensure that analyses are completed following the most current version of ARI's SOP, within required holding and turn around times, and assure that analyses meet the Data Quality Objectives of each project. They will ensure that any client modifications or QA issues are well documented for each sample set, and that all documentation is complete when submitted with each data set.

To ensure that analyses are completed within required hold times, the Supervisors have the authority to balance employee workloads and modify employee work schedules. The Section Supervisors, with the input of the Section Manager, have the authority to request overtime from employees should the workload warrant the additional effort, or to modify employee schedules to extend the operating hours of the laboratory section.

The Section Supervisors shall oversee the day-to-day section operations, using LIMS printouts and verbal or written workload estimates and requests from Project Managers to adjust section efforts as needed. It is also the Section Supervisors' responsibility to inform management (Section Manager, Data Review, and Project Managers), when capacities are limited, so that the appropriate adjustments can be made to reduce workloads or increase laboratory capacities. At no time should sample capacity be allowed to affect the quality of data generated from any laboratory section.

It is the Section Supervisor's responsibility to assure that employees have the proper training for their positions. This training will include training in the methods, use of the LIMS system if applicable, training in correct documentation procedures, and all information necessary for adherence to the ARI QA Program. The Supervisor shall either perform the training personally, or designate the trainer for given methods or procedures. It is the Supervisor's responsibility to test each employee for each method or procedure, and to thoroughly document each employee's advances and current capabilities. The Supervisor shall have the authority to require further training or supervision for any employee, and shall be the authority to approve each employee for working without supervision. There will be a training record for each employee. These will be kept in the laboratory section; copies will be submitted to the QA Manager for record keeping.

It is the Supervisor's responsibility to work with the Section Manager and Project Manager to ensure that Project Requirements are achievable and valid for the given methods. At times clients have requests and/or requirements for methods that are 1) not the method of choice in the laboratory, 2) not presently part of the method as performed by the laboratory, or 3) unachievable by the instruments used in the laboratory. It is the responsibility of the Supervisor, Section Manager and Project Manager to work with the client to resolve these issues before samples are accepted.

It is the responsibility of the Section Supervisor to ensure that each analyst reads and understands all requirements submitted with each sample set, including those for any special analyte, calibration, or data deliverable. It is the Section Supervisor’s responsibility to clarify any issues, with the input of the Section Manager and the Project Manager for the client.

Clients also at times will request modifications to methods, which must be approved by the Supervisor and Section Manager. These modifications must be thoroughly documented and all pertinent information on modifications must be conveyed to the analysts, sample preparation sections, sample receiving, and computer services as needed for implementation.

It is the Supervisor's responsibility to ensure that each employee understands the requirements of all projects they work with. This may necessitate section meetings or project-specific cross-section teams to work with Project Managers for large, specialty projects to ensure that everyone has the same understanding of project requirements.

The Supervisor is responsible for resolution of out-of-control events that have not or cannot be resolved by the analysts, and for ensuring that the analysts complete all documentation. If the Supervisor and laboratory section analysts cannot resolve the issues in a timely manner, the Supervisor's will request the assistance of laboratory management to bring the section into compliance. The Supervisor will also inform Project Management and his/her Section Manager of possible delays, and inform Data Review of possible time constraints they may face in preparation of data submissions from the lab section.

The Section Supervisors shall have the authority, usually in consultation with Laboratory or Project Management to use professional judgment in requiring samples be re-prepared, and shall determine which analysts have the authority to require re-preparation of samples.

It is the responsibility of the Section Supervisor to inform the QAPM, Section Manager and the Computer Services section of any changes in methodologies that will require revision of SOPs, MDLs, Control Limits or the LIMS programming. This includes changes in spiking compounds, spiking levels, preparation methods and analytical methods.

Analysts

> *The analytical staff shall execute all methods following QA Policies, and will write SOPs reflecting the methods exactly as performed. These SOPs will be reviewed for compliance by Section Managers, the Laboratory Manager, and the Laboratory Director, and once approved will be submitted to the QA Manager.*

The analysts are responsible for following the current SOPs (with project-specific modifications if required) in preparing and analyzing client samples and quality control samples to meet the project specific Data Quality Objectives. It is the analyst's responsibility to ensure that he/she understands all requirements of a project before proceeding with sample preparation or analysis.

Analysts are responsible for working with the Supervisor to ensure that all sample preparations and analyses are performed within required holding times and required turn-around times, and that all documentation is completed in a timely fashion. It is each analyst's responsibility to bring any recurrent or anticipated problems to the attention of laboratory management.

It is each analyst's responsibility to correct his/her own errors, to document corrective actions thoroughly, to perform peer review, and to ensure that fellow employees within the section follow documentation procedures.

The Section Supervisor may give lead analysts responsibility for training and evaluation of new staff members. This training will include instruction in the methods, use of the LIMS system if applicable, correct documentation procedures, and all information necessary for adherence to the ARI QA Program. Analysts will be responsible for maintaining all instruments and equipment in optimum operating condition and documenting this maintenance as required by the QA Program.

It is the responsibility of each analyst to request the assistance of Supervisors or Managers in resolving out-of-control situations that cannot be corrected in a timely manner, and to perform the documentation of all corrective action activities.

Quality Assurance Program Manager (QAPM)

> *The QAPM will be responsible for controlling Company SOPs and other internal documents. The QAPM will oversee the scheduling and completion of detection limit studies and control charts. The QAPM will administer the training program, analyst's proficiency documentation and performance evaluation analyses as described in the QA Program. The QAPM will verify that QA policies and procedures are followed at all levels in the Company. The QAPM will produce a "Quality Assurance report to Management" each calendar year.*

The QAPM is responsible for the oversight of the QA Program as defined by the Board of Directors and interpreted by the Laboratory Director and Laboratory Managers.

Part of this oversight will be monitoring of the QA Program through submission of performance evaluation samples, blind QA samples and double-blind QA samples. It is the responsibility of the QAPM, along with the Laboratory Manager, Laboratory Director, Section Managers and Client Services, to determine in which QA Proficiency Programs the Laboratory will participate. The QAPM will be responsible for submitting these samples to the laboratory for analysis, overseeing submission of the results to the appropriate agencies, and for control of documented proficiency results.

The QAPM will be responsible for scheduling laboratory section SOP and procedural reviews and revisions, and section updates of the Quality Assurance Manual. It is the responsibility of the QAPM to work with each Section Manager to attempt to stagger these review schedules across the year within each laboratory section. The QAPM will also be responsible for maintaining document control of all SOPs, bench sheets, logbooks, and other forms used within the laboratory.

All laboratory sections, on an annual basis, will perform detection limit studies for each method used within each section. It is the responsibility of the QAPM to schedule, review, compile, and distribute the results of these studies.

The QAPM is responsible for evaluation of the laboratories' adherence to defined protocols through periodic audits of completed projects and of the laboratory facilities. Following the audit schedule (Appendix K), the QA Manager will perform the scheduled audit and prepare an evaluation that will be submitted to the Board of Directors in the Annual QA Report to Management.

The QAPM will be responsible for evaluation of outside accreditation requested by Client Services. The QA Manager will deliberate with the Laboratory Managers and Laboratory Director on the feasibility of pursuing accreditation based on the scope of the accreditation, the effort required to pursue accreditation and the scope of work that might become available once the accreditation is obtained. If a decision is made to pursue an accreditation, it is the responsibility of the QAPM to coordinate laboratory efforts towards the accreditation.

The QAPM will produce an annual "Quality Assurance Report to Management" to be distributed to ARI management personnel as described in Section 13 of this LQAP.

The QAPM will serve as a resource for quality-related issues for all Laboratory Sections, and will serve management in an advisory capacity.

The QAPM will have documented training in elementary statistics and Quality Systems theory.

Data Reviewers

> *Data reviewers will be responsible for ensuring that all samples have been analyzed by the approved and requested methods, that data calculations are performed correctly, and that analyses meet the Data Quality Objectives of the client. They shall also be responsible for ensuring that the documentation from each laboratory section is intact and complete.*

Data reviewers shall ensure that all samples are analyzed according to approved methods by reviewing the data released by each laboratory section. The data will be evaluated for compliance with all Data Quality Objectives as defined in the method SOP or in the project-specific quality assurance plan, including instrument tuning and calibration, holding time, spiking level, and spiking recovery criteria. Data reviewers will also verify 100% of manual calculations, spot check computer calculations, check electronic data for correct sample matching, and do a 100% check on any manually entered data. Analytical parameters, which have concentration interdependence, will be evaluated in relationship to each other.

Final reports generated will be evaluated to ensure that laboratories are using the current detection limit/reporting limit values and the current control limits. Data will be checked to ensure that all QA issues are addressed and fully documented. Reviewers are responsible for working with Laboratory Supervisors, Laboratory Managers and Project Managers when out-of-control events are incompletely documented, or if data is found to not meet Data Quality Objectives of a project without documentation.

It is the responsibility of data reviewers, the QAPM and section supervisors to work with Computer Services to ensure that the LIMS is updated to the current limits and methods used within the laboratory.

Computer Services

Computer Services is responsible for ensuring that the LIMS correctly reflects the preparations and analyses performed and that the LIMS is updated to include the current SOP, MDL, RL and QL data, as submitted by the QA Manager. Computer Services personnel are also responsible for ensuring that all electronic deliverables for clients are formatted correctly as requested by the Project Managers and that electronic data matches the hardcopy deliverables submitted.

It is the responsibility of the Computer Services Manager to update, or to designate the task of updating, the LIMS as determined by Laboratory Management, including adjustment to current MDL/RL data, additions of analytes to methods, changes in method designations or changes in calculations for methodologies.

Computer Services will be responsible for generating the work list scripts required to allow analysts to enter data into the LIMS, and for generating the report scripts that produce final hardcopy or electronic reports for clients.

Computer Services Management and personnel are also responsible for generation and review of electronic data deliverables (EDD), as requested by clients through Project Management. Computer Services personnel will review the EDD for compliance with the Software Quality Assurance SOP before it is released to the client.

Computer Services will be responsible for informing laboratory Section Managers and Project Managers of any discrepancies found between the EDD and the hardcopy, and for following up on corrections to hardcopy and EDD as required.

Client Services

Client Services (CS) (Project Managers, Sample Receiving, and Sales Management) personnel are the primary interface between ARI's clients and the laboratory sections. CS staff shall be responsible, with the assistance of the Section Managers and Supervisors, for ensuring that the laboratories understand

and can meet the Data Quality Goals and Requirements of each Project before committing laboratory services to the project. CS will monitor the quality of sample processing after they are received.

Client Services Management and Project Managers shall ensure that the laboratories can meet the data quality objectives for a project. The Project Managers are responsible for knowing the capabilities of the laboratory, in order to develop project proposals or accept samples without consultation with laboratory management. It is the responsibility of Client Services to consult with the Laboratory Manager and Section Managers, or supervisors designated by Management, when data quality goals are not included in standard Company policies. Clients may, at times, request modifications to methods that must be approved by the Supervisor and Section Manager. These modifications must be thoroughly documented and all pertinent information on modifications must be conveyed to the analysts, sample preparation sections, sample receiving, and computer services as needed for verification of feasibility. Laboratory Management may determine that a project should not be pursued based on the specific Data Quality Objectives and on current or projected laboratory capacity.

Project Managers shall be responsible for ensuring that project requirements and analytical requests are submitted correctly to all laboratory sections. Once samples have been logged into the laboratory, it is the responsibility of the Project Managers to ensure that all information is available to the laboratories concerning the Data Quality Objectives and deliverables requirements. It is also the responsibility of the Project Managers to convey changes in client requirements to the laboratories and ensure that all paperwork reflects the changes if necessary.

It is the responsibility of Project Managers and Client Services Management to assure that specific EDD formats are submitted to Computer Services and approved as feasible before contracting with a client to provide the EDD.

It is the responsibility of Project Managers to notify clients of out-of-control events, “problem” samples, or anticipated turn-around time delays, as conveyed to them by Laboratory Management. It is also the responsibility of Project Management to work with Laboratory Management in setting priorities during times of heavy sample workloads.

Project Managers shall be responsible for coordinating data submissions and compiling hardcopy data for final submission to the client. This involves conducting a fourth level data review, from which any data which is found to contain errors that were not found earlier in the review process is returned to the Data Reviewer for correction and/or corrective action. The Project Manager will be responsible for compiling all analyst notes into a project narrative. This will include discussion of any sample receipt discrepancies, sample preparation and analysis difficulties or non-compliance, and any corrective actions that may have been required during processing. It will also discuss quality control analyses and results if applicable to the sample set.

Project Managers shall work with Laboratory Management in determination of the direction of growth for ARI, as the Project Managers are best able to define the analytical needs of clients based on new technologies and new environmental regulations.

SECTION 3: PERSONNEL QUALIFICATIONS AND TRAINING

The production of quality analytical data is dependent upon a laboratory staff with qualifications and training necessary to perform assigned tasks. All personnel employed by ARI will receive adequate training and instruction specific to their responsibilities. Prior to assigning a staff member full responsibility for performing a laboratory procedure, her/his skills will be evaluated and verified acceptable. It is the obligation of ARI′s supervisors and managers to ensure that personnel are qualified to successfully perform all assigned duties.

ARI′s training program is described in SOP 1017S (*Training and Demonstration of Proficiency*). The procedures described in this SOP assure that all ARI employees are proficient at the tasks required to produce quality analytical data. The SOP also provides for periodic review of each employees training and proficiency status, which may indicate any need for additional or remedial training. All training and review procedures are documented as described in the SOP.

Basic elements of ARI′s training program are:

1. All employees are required to read and document their knowledge of non-technical documents that describe general policies in place at ARI. These documents include ARI′s *Employee Manual* and ARI′s *Chemical Hygiene Plan*.
2. All technical employees are required to read and document their knowledge of ARI′s *Laboratory Quality Assurance Plan* and quality assurance policies.
3. All new employees must attend a Quality Assurance Orientation during which ARI′s general and specific requirements for the production of quality analytical data are emphasized.
4. All new technical employees will attend a laboratory specific technical orientation conducted by their laboratory supervisor or manager that provides specific information about laboratory operation.
5. All employees will complete an ‘on the job’ training program designated by their supervisor. The training program will be laboratory, SOP and employee specific. The training is

incremental with each step documented in an employee Training File. While an analyst is in the training period, her/his supervisor or trainer must approve all analytical work.

6. Upon completion of the training program a technical employee must complete an Initial Demonstration of Capability (IDOC) as described in ARI SOP 1017S. An analyst is considered proficient and may perform analytical procedures without supervision only after they have completed training and a successful IDOC.
7. The proficiency of each employee performing a given laboratory SOP will be continually monitored and documented as described SOP 1017S. An employee must continually generate data that meets all of ARI's published acceptance criteria for a given SOP to be considered proficient. Unacceptable results or insufficient number of analyses performed in a calendar quarter will result in revocation of proficiency. This will result in a remedial training program.
8. Each analyst is responsible for maintaining a training record as described in SOP 1017S. The training record will document an employee's experience, training and capability. The training file will be maintained in the analysts' laboratory.

SECTION 4: FACILITIES AND EQUIPMENT

4.1 Facilities

ARI′s facilities have been designed to allow for efficient sample processing and analysis while maintaining consideration for the health and safety of the staff. The facility accommodates the following operations:

Sample receipt and storage
Sample container preparation and shipment
Sample preparation and analysis (organic and inorganic)
Project planning and management
Quality assurance
Data review and report generation
Computer programming and operations
Records storage
Instrument spare parts storage
Frozen sample archive
Short-term hazardous waste storage

A detailed description of ARI′s facilities is included as Appendix C.

4.2 Security

Facilities

To ensure that security at ARI is maintained, access to the facilities is limited to employees and escorted visitors. Upon arrival, ARI visitors are required to register at the reception desk, and must sign out prior to leaving. Visitors will be escorted at all times. A receptionist constantly monitors the main entrance. Other laboratory entrances remain closed at all times and can only be opened from the outside by key. Key access to the facility is controlled; keys are issued on a limited basis depending on access needs.

As a result of controlled access and a monitored alarm system, the entire facility is considered a secure area. This eliminates the need for locked sample storage refrigerators, data storage areas or file cabinets.

Data Access

The Computer Services Manager controls security of, and access to, electronic data on the LIMS. Security measures are required to ensure data integrity, but must not be so restrictive as to prevent data accessibility. The security measures taken at ARI are to prevent intentional intrusion by outside parties. These measures include building security, limited computer system access, password systems, encryption, firewalls and the use of virus protection programs. ARI′s Intranet is protected from outside tampering by a proxy server (firewall) connection to the Internet.

LIMS - System Security

Building/Computer Room Security

Access to the building is restricted to employees, vendors with security passes, and escorted visitors. Room 203 contains the computer and main console for the LIMS system. This room is closed and locked at all times. Access to this room is limited to Computer Services personnel, escorted repair technicians, and escorted visitors. Only Computer Services personnel will be allowed access to the main console.

System Password Policy

User name and password restrict access to the LIMS computer. Remote access to the LIMS server is not allowed.

Database Access Restrictions

Interaction with the database is menu-controlled and allows the LIMS Manager to restrict access. Technicians may be given the ability to fill a limited number of work lists, with no authorization to distribute data. Some users may be given “read only” access to the database.

Users will be given access to the database only to complete tasks for those analyses for which they are responsible. No users are to be given access to the shell or command prompt unless 1) they have completed the appropriate training and 2) administrative access to the computer systems is required by their job function

4.3 Safety

Ensuring that all sample processing and analysis procedures are performed under safe conditions is an important consideration at ARI. While safety is the responsibility of all staff members, ARI′s Safety Committee meets monthly to review the safety activities of all laboratory sections and to ensure that all operations and equipment meet safety criteria. *The*

Chemical Hygiene Plan details those safety procedures and requirements that must be followed at ARI. *The Chemical Hygiene Plan* is reviewed annually and updated as needed to incorporate any changes to ARI′s safety program.

4.4 Instrumentation and Support Equipment

4.4.1 Instrumentation

Generation of quality data is dependent upon instrumentation and support equipment that is in optimum operating condition. All instrumentation and support equipment will be optimally maintained following method requirements and/or manufacturer's recommendations. Preventative maintenance is performed on a scheduled basis, with more frequent maintenance during periods of increased sample load or after analysis of highly contaminated samples. Separate, permanently bound logbooks are provided for and kept at or near each instrument. The logbooks are used to record all instrument maintenance, routine and non-routine. When non-routine maintenance is required the following information must be recorded:

1. A statement of the problem or symptom that requires correction.
2. Details of the maintenance procedure including listing the parts repaired or replaced.
3. Documentation that the instrument has returned to routine performance.

Spare parts are kept on hand when possible; necessary parts are ordered on an expedited basis to minimize downtime.

Currently available Laboratory Instrumentation is detailed in Appendix D.

4.4.2 Support Equipment

4.4.2.1 <u>Thermometers</u> in use at ARI are traceable to an NIST standard and are calibrated or verified annually. The procedures are described in SOP 1020S. When appropriate, thermometers are assigned a correction factor based upon the most recent calibration. ARI personnel must calculate and record corrected temperatures.

4.4.2.2 <u>Water Bath</u> temperatures are recorded before each use to assure the temperature is acceptable for its intended use.

4.4.2.3 Incubator temperatures (corrected) are recorded and at least twice a day while in use. The date and time of each observation is recorded.

4.4.2.3 Oven temperatures are recorded before and after each use.

4.4.2.4 Refrigerator and Freezer temperatures are recorded automatically every 30 minutes by ARI's "ThermoLogger" computer system. The temperature of several refrigerators and freezers not connected to "Thermologger" are recorded daily.

4.4.2.4 Balance accuracy is verified daily prior to use with two Class S weights that bracket the normal weighting range of the balance. A balance must be accurate to ±0.1% or ±0.5 mg whichever is greater. All analytical balances are professionally cleaned and calibrated annually by an outside contractor. Class S weights are calibrated every five years by an outside contractor. Calibration reports are filed in the QA Office.

4.4.2.5 pH Meters are standardized prior to each use with at least two standards, one at 4.0 and one at 7.0 pH units. The meters are checked prior to each use with a pH 7.0 buffer.

4.4.2.6 Variable Volume Pipette accuracy is verified monthly following the procedure in SOP 1015S.

4.4.2.7 Mechanical Burettes are calibrated quarterly following the procedure in SOP 1015S.

4.4.2.8 Sample Containers – Upon client request ARI supplies containers for collection of field samples. All containers supplied for organic and trace metals analyses are certified pre-cleaned by the manufacturer. When the manufacturer's certified concentration is greater than ARI's reporting limit for a specific project, a container is used to prepare a method (bottle) blank. ARI certifies that the containers from the same lot are suitable for sample collection when target analytes are not detected in the bottle blank. Containers for conventional analyses are not pre-cleaned and are certified internally by ARI following the procedures in Appendix 12.3 of ARI SOP 001S (Sample Receiving).

Container lot numbers are recorded when containers are sent to a client.

4.4.3 Chemical Standards and Reagents

4.4.3.1 Reagent Water Supply

ARI maintains a centralized water purification system. The quality of the water produced is monitored and documented daily in a bound logbook. All reagent / de-ionized water used within the laboratory meet or exceed ASTM Type II Standards. Water used in the Volatile Organic Laboratory is also filtered through activated charcoal to remove organic compounds.

4.4.3.2 Chemical Standards

Most standards used to determine the concentration of target analytes are purchased as certified solutions. In general the standards are traceable to a National Institute of Standards & Technology standard. A Certificate of Analysis and/or traceability for quantitative standards is filed in the QA Section when available. All standards (traceable, non-traceable and those prepared by ARI) are verified by comparison with standard reference materials or existing standards in use. ARI documents the source, date of receipt, required storage conditions and an expiration date for all standards. Containers used to store standards are labeled with an expiration date. Receiving, storage and preparation of calibration standards is described in SOPs 526S (Metals Analysis), 620S (Conventional Analysis), 704S (Volatile Organic Analysis) and 1012S (GC and GC-MS Analyses).

4.4.3.3 Chemical Reagents

Many of the analytical processes in use at ARI require chemical reagents that are not directly used in the calibration process. These reagents are used for analyte preservation, adjustment of pH, formation of colorimetric indicators, etc. The reagents are purchased in a grade and purity sufficient for their intended use. The receipt of all reagents is recorded in the Chemical Receiving Logbook where a unique Inventory Number is assigned to each reagent. Each original reagent container is labeled with an Inventory Number, the date it is opened and an expiration date as appropriate. A Certificate of Analysis is obtained for reagents when available and archived in the QA Office.

Solutions prepared from reagents are recorded in the Reagent Preparation Logbook. The logbook includes a unique Reagent Number that is traceable to the Chemical Receiving

Logbook. Reagent containers are labeled with Reagent Number, date of preparation, expiration date, and preparer's identification.

Procedures for Reagent Receiving and Preparation are detailed in SOP 1013S.

Trace Metals Acids

To ensure the quality of acids, nitric and hydrochloric, used for trace metals analyses, only the highest quality, certified "metals free" acids are purchased. Each lot received is analyzed for purity prior to use in the laboratory to assure that it is acceptable for use. Whenever possible, entire lots will be reserved for use exclusively by ARI. This minimizes the possibility of receiving contaminated or unacceptable acid.

Solvents

To ensure the quality of solvents used for sample preparation and analysis, the highest purity of solvents required for sample processing will be used. Purity checks are performed on solvent lots received by the laboratory. Only those solvent lots determined acceptable will be used for sample processing. Whenever possible, entire solvent lots will be reserved for use. This minimizes the possibility of receiving contaminated or unacceptable solvents.

Compressed Gases

To reduce the possibility of system contamination, compressed gases and liquids used for operating analytical instrumentation will be of a specified purity level. Any cylinder suspected of introducing contamination into a system will be promptly replaced.

4.5 Computer Systems

ARI maintains several data systems. These are used to automate such diverse functions as accounting, payroll, sales and marketing, sample receiving, instrument data collection, production of hardcopy and electronic data deliverables, intra- and internet applications and project management. Specific information about these systems is contained in Appendix D and various SOPs.

ARI maintains a Laboratory Information Management System (LIMS) that stores analytical data, calculates final results and produces final reports (both hardcopy and electronic). The LIMS system is the major data system used at ARI. A separate Software Quality Assurance Plan outlines the QA/QC procedures for the LIMS system.

SECTION 5: LABORATORY DOCUMENTATION AND RECORDS

All laboratory operations and procedures performed during sample processing are documented in logbooks, notebooks and on laboratory forms and bench sheets. Analytical data and copies of paper documents are also stored electronically. Consistent use of standard documents throughout the laboratory ensures that all activities will be traceable and serves as objective evidence of the work performed.

All procedures performed at ARI will be detailed in Standard Operating Procedures (SOPs). Sample preparation and analysis SOPs will reference approved analytical methods and detail the actual procedures followed by ARI staff. SOPs for non-analytical activities will detail the procedures developed specifically for use at ARI.

5.1 Responsibilities

All staff members are responsible for complete and accurate documentation of laboratory activities. Each laboratory section develops a comprehensive set of documents (bench sheets, forms, etc.) to record all activities performed in that section. All staff members are responsible for reviewing and understanding SOPs, and must sign a record to document this fact. The QAPM is responsible for maintaining control of laboratory documents and ensuring their consistent use.

To ensure that all documents, SOPs in particular, accurately reflect the activities performed at ARI, section supervisors and managers are required to review all documents annually and recommend changes to the QAP. The QAPM is responsible for coordinating document revisions and ensuring that all staff members have access to the most current laboratory documents.

5.2 Document Control

ARI′s Quality Assurance Program requires that all forms and SOPs used within the laboratory be monitored to ensure that only the currently approved version of the documents are in use, centrally organized, and readily available to all staff members. All documents will include a revision date. The LQAP and SOPs will also have an effective date. The time between the revision and effective dates will be used for training and orderly implementation of changes.

Electronic copies of laboratory documents will be maintained as part of the quality assurance files. Each laboratory section maintains working copies of pertinent forms and SOPs. The QAPM coordinates the generation of new forms or SOPs and modifications to existing documents. Log number assignments will be as follows:

Laboratory Section	Form Number	SOP Number
Client Services	0001 - 0999	001 - 099
Computer Systems	1000 - 1999	100 - 199
Data Services	2000 - 2999	200 - 299
Extractions	3000 - 3999	300 - 399
GC Laboratory	4000 - 4999	400 - 499
Metals Laboratory	5000 - 5999	500 - 599
Conventional Laboratory	6000 - 6999	600 - 699
Volatile Organic Laboratory	8000 - 8999	700 - 799
Semi-volatile Laboratory	7000 - 7999	800 - 899
Quality Assurance Monitoring	10000 - 10999	1000 - 1099
GeoTech Laboratory	11000 - 11999	1100 - 1199

Document numbers will be include an F for forms and an S for SOPs i.e. 101F or 1234S. Document Control Logs of all forms and SOPs, detailing the form name and number, revision number and revision date will be maintained by the QA Officer. Outdated documents will be maintained in an electronic archive file.

The QAPM will distribute new and revised documents to the appropriate laboratory sections. Section staff will replace outdated copies of the document with the revised version. Laboratory forms and SOPs will be generated or revised on an “as needed” basis, and will be reviewed and revised as at least annually. Only the latest version of a form or SOP will be available in each laboratory. Section supervisors will periodically review these documents and recommend changes to be implemented by the QAPM. A comprehensive review of all laboratory documentation will be performed annually at the direction of the QAPM.

To maintain document security, release of documents to clients or other outside agencies will be controlled by the QAPM. The QAPM will record the document to be released, revision number, person and agency receiving the document, and the release date. All documents generated by the laboratory will be considered proprietary. ARI permission must be obtained by anyone releasing the document to other agencies or including the document in a project or quality assurance plan.

5.3 Reference Documentation

To provide an understanding of the procedures employed to generate quality data, a comprehensive set of reference materials is available to staff members. All activities performed within the laboratory can be referenced to a method or SOP. The laboratory maintains copies of the following method compilations:

Code of Federal Regulations (Section 40)
Test Methods for Evaluating Solid Waste (USEPA SW-846)
USEPA Contract Laboratory Program Statement of Work for Organics Analysis
USEPA Contract Laboratory Program Statement of Work for Inorganic Analysis
Methods for Chemical Analysis of Water and Waste (USEPA 500 and 600 series methods)
Standard Methods for the Examination of Water and Wastewater
Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound (PSEP)
US Naval Facilities Engineering Support Activity –NFESC (formerly NEESA).
Hazardous Waste Remedial Actions Program (HAZWRAP)
State of Alaska Department of Environmental Conservation (ADEC)
Oregon Department of Environmental Quality (DEQ) Petroleum Hydrocarbon Methods
Washington Department of Ecology (WDOE) Guidance for Remediation of Releases from Underground Storage Tanks (Appendix L)
Washington State SARA
AFCEE Project Quality Assurance Plan
Washington State EPH/VPH Methods
National Environmental Laboratory Accreditation Conference
Department of Defense Quality Systems Manual
Washington State Sediment Sampling and Analysis Plan

Other methods followed within the laboratory are also available. Published modifications to analytical methods will be reviewed and incorporated into laboratory SOPs. If a method for a parameter is developed by ARI, it will be detailed in an SOP. SOPs will be available for all laboratory activities. Each laboratory section will maintain a file or notebook of SOPs pertinent to that section. A compilation of all laboratory SOPs is maintained as part of the Quality Assurance Program files. A listing of laboratory SOPs is included as Appendix E.

The Quality Assurance Manual provides an overview of the laboratory-wide Quality Assurance program. A copy of the Quality Assurance Manual is distributed to all laboratory sections. Distribution of the QAP is coordinated by the QAPM.

ARI maintains a file of various laboratory and environmental publications and reference texts. These reference materials are available to all staff members. Operation and maintenance manuals are available for all equipment and instrumentation used within the laboratory. Additionally, senior level staff members are available to serve as reference sources. These staff members have numerous years of pertinent experience and can provide insight and guidance for all procedures and laboratory activities.

5.4 Quality Assurance Policies

Quality Assurance Policies provide standards and procedures to guide ARI employees in proper implementation of the QA Program. Appendix P includes current QA Policies.

5.5 Worksheets and Logbooks

Use of Laboratory Forms and Logbooks

All activities noted on laboratory forms and logs are recorded in blue ink. Initials of the staff member performing the activity, as well as the date the activity is performed are noted on all forms and logs. Any supplementary information about the activity, such as unusual observations or suspected procedural errors are noted on the forms and logs. The QAPM or his/her designee prepares and controls laboratory logbooks.

Changes to existing information is annotated by drawing a single line through the original entry and initialing and dating the deletion. Correct information is written above the deleted entry. When appropriate to clarify the intent of the change a note describing the reason for the change is added. The use of correction fluids or other techniques that cover an entry in its entirety is forbidden on laboratory documents.

Since sample processing within an analytical laboratory involves many detailed steps, documentation can be quite extensive and varied. The following guidelines will be followed to encourage consistency in laboratory record keeping:

Standard Logbooks

Preparation of all stock and working standards is documented in the appropriate standards logbook. Each entry includes preparation date, initial and final concentrations (including solute and solvent amounts), standard ID number, expiration date and the identity of the person preparing the standard. Stock solution entries include standard lot number and supplier. Working solution entries include the stock solution ID number. Commercially prepared stock standards are recorded in the stock standard logbook.

Sample Storage Temperature Logs

The temperature of all refrigerators and freezers used for sample and standards storage is monitored daily. The temperature and recorder's initials are recorded on the temperature log attached to each unit. The acceptable temperature range for each unit is noted on the log sheet. Any out of control temperatures and/or corrective actions, must be noted on the log sheet and reported to appropriate personnel (Lab Supervisor and QA Manager)

Balance Calibration Logs

The true and measured values for each calibration check weight are recorded, along with the date and recorder's initials. Any actions taken, such as notifying the QAPM of malfunctions is indicated alongside the entry for that date.

Instrument Logs

The Instrument Run Logs must detail all samples analyzed on a given instrument for a given parameter. Instrument conditions, analysis date and time for each sample, analyst initials and standard or sample identifications in the analytical sequence must be recorded in the log. Comments related to sample analysis and minor maintenance are noted on the instrument logs. For GC/MS analyses, instrument performance is documented by recording internal standard response alongside the sample identification.

Sample Preparation/Analysis Worksheets

Sample preparation and analysis activities are documented on appropriate worksheets. Sample identifications, weights or volumes used, intermediate cleanups, final volumes, preparation dates and analyst initials will be noted as well as any observations about sample condition. Any issues encountered during sample preparation are also noted. Surrogate and spiking solution ID numbers, and concentrations added to the samples, must be indicated on the bench sheet.

For some parameters, analytical results are summarized on an analysis worksheet. Sample identifications, sample preparation information, sample results, quality control results, analysis date, analyst initials and reported detection limits must be indicated on the worksheet. Any necessary data qualifiers are also noted on the worksheet.

Maintenance Logs

All major maintenance performed on instrumentation or laboratory equipment must be documented. Maintenance performed, date and analyst performing the maintenance, and steps taken to verify that the maintenance was successful are detailed in the log. Routine maintenance of GC-MS instruments is documented on "maintenance cards" attached to each instrument. The demonstration that GC instruments are in-control following maintenance is documented in the instrument run log.

Individual Laboratory Notebooks

Staff members preparing USEPA CLP samples must maintain unique laboratory notebooks for these analyses. Each case submitted is documented on a separate, sequentially numbered page. A listing of all samples prepared as part of the case, the date and the preparer's initials, and any notes specific to sample preparation must be annotated in the logbook. Individual notebooks are used only when required by a specific contract. All sample preparation information is recorded on a laboratory bench sheet.

5.5 Document /Data Storage and Archival

Logbooks

All active logbooks will remain in the appropriate laboratory sections. Completed logbooks will be forwarded to the QAPM for archival.

Magnetic Tapes and Diskettes

When instrument capabilities permit, all data generated is archived and stored on magnetic tapes or disks. The electronic media remains on file for five years.

Chromatograms and Instrument Documentation

Electronic or paper copies of chromatograms, instrument calibrations, quantification reports and any other printed documentation generated during sample analysis are maintained as part of the permanent data files. All hardcopy data remain on file at ARI for five (5) years or as specified by contract.

Project Data and Documentation

Project data and support documentation, electronic or paper copies, will be filed a minimum of five years, or as specified by contract.

SECTION 6: SAMPLE CONTROL

All samples analyzed by the laboratory will be monitored in accordance with sample control procedures. Sample control includes operations such as container preparation, sample collection, receipt and storage, and tracking of the sample throughout all processing steps. Documentation of all sample control activities and adherence to standard procedures is an important aspect of ensuring that data quality objectives are met.

6.1 Sample Collection

Production of quality analytical data begins with proper sample collection. Improper sampling procedures may result in inaccurate final results. Although the laboratory is not routinely involved with sample collection, it will minimize the possibility for error by providing clients with appropriate sample containers and sampling instructions for the requested parameters. If, upon receipt, sample integrity appears to be compromised, the client will be immediately notified to allow for re-sampling if necessary.

6.2 Sample Container Preparation and Shipment

To minimize the possibility of contamination from containers furnished by outside sources, the laboratory will furnish all necessary sample containers for client projects when requested by the client. Sample containers, pre-cleaned to EPA specifications, or certified clean by the manufacturer or ARI, are supplied for most parameters. Containers for special purposes may be acquired upon request. Lot numbers for containers are tracked to link bottle orders to lot numbers.

A blank sample label is affixed to each sample container prior sending the container to a client. The sample label allows for recording of the following information at the time of collection: client name, client sample identification, sampling site, date and time of sample collection, analytical parameters, and any preservatives used. Sample labels provided by ARI are coated to prevent bleeding of recorded information if labels become wet.

To ensure that the correct number of appropriate sample containers are prepared and submitted to the client, a Bottle Request is completed by a Client Services staff member or Project Manager at the time sample containers are ordered by the client. All necessary preservatives are also noted on the Bottle Request. The Bottle Request is then forwarded to appropriate personnel in the Sample Receiving Section for order preparation. All required containers will be gathered and preservatives added as specified. A copy of the Bottle Request accompanies the sample containers to allow the client to verify that the order is properly filled. Additional containers will be supplied for quality control purposes and in case of container breakage or sampling complications. A complete listing of containers and preservatives used within the laboratory is included as Appendix F.

To facilitate transportation of containers to the sampling site, sample containers will be placed in coolers along with appropriate packing material. The inclusion of packing materials, such as vermiculite or “bubblewrap”, is provided to minimize the possibility of container breakage and cross-contamination. Sample containers will be organized in the coolers per analytical or client specifications. Depending on client preference and project requirements, coolers and sample containers will be shipped to a specified location, delivered by ARI courier, or held at the laboratory for pick up. To ensure that sample identification, analytical parameters, and sample custody are properly documented, Chain of Custody records will accompany all sample container shipments. When appropriate, as for drinking water source sampling events or for parameters that require preservation in the field, sample collection instructions will also be included with shipments.

6.3 Sample Admission

All samples received by the laboratory are processed in a central Sample Receiving area. To ensure the safety of staff members receiving samples, coolers will be opened under a hood or in a well-ventilated area. Appropriate protection, such as disposable gloves, safety glasses and laboratory coats will be worn during sample receipt and log-in. Additionally, all general safety practices as specified in ARI’s Chemical Hygiene Plan will be employed.

Upon receipt, sample coolers will be inspected for general condition and custody seals. Time and date of sample receipt, as well as identification of the staff member receiving the samples, will be indicated on each Chain of Custody record accompanying the shipment. Cooler temperatures will be determined using an IR temperature measuring device or by placing a thermometer in the cooler immediately after the cooler is opened. If samples cannot be logged-in within 30 minutes after receipt, the sample coolers will be tagged and placed in the walk-in sample storage refrigerator for short-term storage. Chain of Custody records for the stored coolers will remain in Log-In to ensure that processing of the stored samples is not overlooked.

Samples to be processed will be removed from the coolers and organized by sample identification. The number and type of sample containers received will be verified against the Chain of Custody record. Each sample container will be examined to verify that the condition is acceptable and that sample integrity has not been compromised during shipment. Sample containers broken during shipment should be handled according to procedures detailed in the Chemical Hygiene Plan (Section 5, Waste Disposal Procedures).

After sample organization and initial inspection has been completed, sample information will be entered into the LIMS, and a Service Request will be generated for the sample set. The Service Request serves as a work order for the laboratory. The Service Request will contain the following information:

Client Name
Client Project Name and/or Number
Client Contact
Verified Time of Sample Receipt (VTSR)
Required Turnaround Time
Laboratory Job Number
Client Sample Identifiers(s)
Laboratory Sample Number(s)
Required Parameters
Additional Analytical Requirements/Comments

Also entered into the LIMS are the number of sample containers for each sample, sample conditions, and cooler temperatures.

A sequential laboratory job number will be assigned to each sample set. Laboratory sample numbers, determined by the job number and a sequential letter, will be assigned to each sample. Containers for each sample will also be numbered sequentially. The accuracy of sample container labeling is verified by a second person. These identifiers will be used to monitor the sample set and container throughout sample processing. All samples logged for the sample set and the analytical parameters required for each sample will be indicated on the Service Request. Client specific quality control requirements and any other pertinent information indicated on the Chain of Custody Record will also be noted. Discrepancies between the Chain of Custody record and sample containers will be noted, as well as discrepancy resolutions. To reduce the possibility of inaccurate sample processing, the sample receiving staff working with the Project Manager will resolve all noted discrepancies prior to releasing the samples to the analytical sections.

Upon completion of sample log-in, all documentation will be placed in a master folder and forwarded to the assigned Project Manager for review and approval. The master folder will be color-coded as follows:

Master File Color	Designation
Red	Accelerated Turnaround (≤ week)
Blue	Accelerated Turnaround/Fuels
Clear	Routine Turnaround

The Project Manager will review all aspects of the documentation, specify any additional analytical requirements and resolve any remaining discrepancies before sample processing begins. After Project Manager final approval has been obtained (indicated by the Project Managers initials and the date on the Service Request and laboratory-specific parameter sheets), the master file will be returned to Log-In for preparation of laboratory job folders. A job folder will be created for each laboratory section involved in sample processing for a given project. Laboratory job folders are color-coded as follows:

Job Folder Color	Designation
Red	Accelerated Turnaround (≤ 10 days)
Manila	Normal Turnaround (11 to 14 days)
Blue	Accelerated Turnaround (≤ 7 days) for Fuels Analyses (NWTPH, AK103 etc.)
Yellow	Extended Turnaround (>14 day TAT)
Other (Green, Purple ,etc)	Client or Project Specific Analyzes

Copies of the Service Request and all pertinent laboratory-specific documentation required to accurately complete sample analysis will be placed in each laboratory job folder. Laboratory job folders will then be distributed to appropriate laboratory sections for analysis and incorporation into the section tracking system.

Subcontracting Policies

ARI may be required to subcontract work to other laboratories. The following policies are followed to assure that data produced by a subcontractor is high quality, defensible and will meet the client's expectations.

1. ARI's client must be made aware that samples will be subcontracted and what laboratory will perform the analyses.
2. Subcontractor laboratories must qualify to perform the analyses using the same criteria applied to ARI. When appropriate, subcontracted laboratories must submit proof of certification or accreditation, quality assurance plans, standard operating procedures, results of method detection limit studies, control limits to ARI. ARI may at its discretion perform an on-site assessment of subcontracted laboratories. Failure to submit requested documents or refusal of an on-site assessment will disqualify laboratories from subcontracting ARI sample analyses.
3. ARI will not subcontract Department of Defense work to be performed under the Quality Systems Manual (DoD-QSM) unless the subcontract lab is approved to perform DoD-QSM analyzes.
4. The sample information and analytical requirements are first entered into the ARI LIMS in the same way that samples for in-house analyses are processed. Subcontractor laboratories are contacted to verify their preparedness, and samples are then submitted to them using ARI chain-of-custody forms. These chain-of-custody documents are included in the master folder for the project.
5. ARI may request that subcontract laboratories analyze, on double blind performance testing (PT) sample obtained from commercial vendors at the subcontractor's expense.
6. The laboratory must be willing to maintain an annual contract with ARI, and must list ARI as a co-insured on the subcontract laboratory's liability insurance policies.
7. Financial stability is also evaluated on a lab-by-lab basis.

6.4 Sample Custody

To ensure the traceability of sample possession, chain of custody is documented from sample collection to completion of final analysis, and is maintained during sample storage in archive prior to disposal. This is achieved through completion of a written chain of custody record. Custody of all samples and extracts processed by the laboratory is documented at each step of the analytical process.

The National Enforcement Investigations Center (NEIC) of EPA defines custody in the following ways:

It is in your actual possession, or
It is in your view, after being in your physical possession, or
It was in your possession, then you locked or sealed it up to prevent tampering, or
It is in a secure area.

Sample handling may vary and specific custody procedures have been developed for each laboratory section.

<u>Custody at Sample Log-in</u>

A Chain of Custody Record must accompany all samples received by the laboratory. This record documents all sampling activities as well as persons handling the samples prior to receipt by the laboratory. Sample receiving staff assumes custody of samples upon receipt from the client or courier. Samples will remain in the custody of Sample receiving until the samples are delivered to a laboratory section. Should samples require shipment to a subcontracting laboratory, a separate Chain of Custody Record will be completed to document the sample transfer. Chain of Custody records will be included with sample data reports in the final analytical package submitted to the client. Copies of these records will be filed with project data.

<u>Custody of Volatile Organic Analysis (VOA) Samples</u>

Upon completion of sample the sample receiving process, samples requiring analysis for volatile organic analysis will be placed in the VOA refrigerator designated for incoming samples and logged into the VOA sample receipt logbook. The samples are now in the custody of the VOA laboratory. To avoid possible cross-contamination of low level samples, those samples known or suspected to contain high levels of contaminants, such as underground storage tank (UST) samples, will be stored in a separate refrigerator prior to analysis.

VOA Laboratory analysts complete the receiving process and move the samples to a refrigerator designated for "active" samples. Samples removed from storage for analysis are considered to be in the custody of the analyst responsible for sample processing. All samples to be analyzed will be listed in the analytical logbook for the selected instrument. Laboratory and client sample identifications, the bottle number and identification of the analyst performing the analysis will be indicated in the logbook. If it is necessary for sample custody to be transferred to another instrument or analyst, the second analyst will record this information. Thus, custody of a given sample can be traced throughout the analytical process, regardless of the number of instruments or analysts involved. Analysts will initial all raw data generated from sample analysis, to further document sample custody.

After completion of sample analysis, soil and intact water sample containers will be placed in the refrigerator designated for sample archival. Any water sample remaining in the container after completion of analysis will be considered compromised and will be discarded. The samples will remain in archive and in the custody of the VOA laboratory until final disposal.

Custody of Semi-volatile Organic Analysis (SVOA) Samples

Upon completion of sample log-in, samples requiring extraction for organic parameters will be placed in walk-in cooler number 5. All samples placed in the cooler will be logged into the *Walk-in Admission Logbook*. Removal of samples from the refrigerator for processing by Extractions or Conventional personnel must be indicated in the *Walk-in Admission Logbook*. Samples stored in this walk-in refrigerator remain in Log-In custody until removed to a laboratory for processing.

The analyst responsible for the custody and initial handling of samples within the sample preparation laboratory will be indicated on the Sample Preparation Worksheet. All analysts involved in the subsequent steps of sample processing will also be indicated on the worksheet. Residual sample volumes will be archived in the refrigerator designated for extractable organic samples. Transfer of residual samples to this refrigerator will be documented in the *Sample*

Archive Refrigerator Logbook. Transfer of prepared sample extracts to the appropriate analytical sections will be documented in the Extract Log in the preparation laboratory and in the Extract Log in the analytical section. Upon extract transfer, the analytical section receiving the extract assumes custody.

Extracts removed from storage for analysis are considered to be in the custody of the analyst responsible for analysis. Removal of extracts for analysis will be indicated in the Extract Log in the analytical section. All extracts to be analyzed will be indicated in the analytical logbook for the selected instrument. Laboratory and client sample identifications, as well as the analyst performing the analysis will be indicated in the logbook. Analysts will initial raw data generated from extract analysis to further document sample custody. After completion of analysis, extracts will be placed in the refrigerator designated for archive. Extracts will remain in storage and in the custody of the analytical section until final disposal.

Custody of Inorganic and Metals Samples

Upon completion of the sample receiving process, samples requiring preparation or analysis for inorganic parameters will be placed in the designated walk-in cooler. Selected samples such as those requiring a critical analysis are placed directly in the laboratory. Removal of samples from the refrigerators for digestion and/or analysis will be indicated in the *Walk-in Admission Logbook* for the appropriate refrigerator. Samples stored in the walk-in refrigerators remain in Log-In custody until the laboratory removes the samples for processing.

The analyst responsible for custody and initial handling of samples within the metals preparation laboratory will be indicated on the Sample Digestion Worksheet. All analysts involved in the subsequent steps of sample processing will also be indicated on the worksheet. Transfer of completed sample digests to the metals instrument (analysis) laboratory will be documented by the metals preparation laboratory. Upon transfer of digests, custody is considered to be the responsibility of the analytical section receiving the digests.

Digests removed from storage are considered to be in the custody of the responsible analyst. All digests to be analyzed will be indicated in the analytical logbook for the selected instrument. Laboratory sample identifications and the analyst performing the analysis will be indicated in the logbook. If it is necessary for digest custody to be transferred to another instrument or analyst, the second analyst records this information. Thus, custody of a given digest can be traced throughout the analytical process, regardless of the number of instruments or analysts involved. Analysts will initial all raw data generated from digest and analysis to further document sample custody. After completion of analysis, digests will be stored by and remain in the custody of the analytical laboratory personnel until final disposal.

The analyst performing the sample analysis will remove samples requiring analysis for other inorganic (conventional) parameters from storage. Removal will be documented in the *Walk-in Admission Logbook*. Custody of the sample will be considered to be the responsibility of that analyst. All samples to be analyzed will be indicated on the worksheet for the required parameter. Laboratory sample identifications and the analyst performing the analysis will be indicated on the worksheet. If it is necessary for sample custody to be transferred to another instrument or analyst, the second analyst will record this information. Thus, custody of a given sample can be traced throughout the analytical process, regardless of the number of instruments or analysts involved. The analysts' initials will be indicated on the worksheet to further document sample custody.

<u>Special Chain of Custody Requirements</u>

Should a client project require additional or more detailed custody documentation, requirements will be incorporated into the procedures for that project. Samples processed as part of the USEPA Contract Laboratory Program require more stringent chain of custody procedures. For this program, removal of samples and extracts for analysis (or any reason) will be documented in the Sample Control Log. Date, time and reason for removal, and date and time of return, will be fully documented. Removal of samples or extracts for permanent archiving or disposal will also be fully documented in the Sample Control Log.

6.5 Sample Archival and Disposal

After completion of analysis, unused sample aliquots are routinely stored for a specified period of time: 30 days for water samples and 60 days for soil samples. Colored markers are placed on samples with specific storage requirements during the sample receiving process. The color-coding is defined in the following table:

Label Color	Storage Requirement
Red	Hold until further notice
Orange	Suspected Hazardous
Yellow	Shared Sample Containers
Blue	Samples to be frozen

Samples submitted for archival will be logged into the Sample Archive Logbook. Laboratory and client identifications, as well as archive date will be indicated in the logbook. The anticipated disposal date for the sample set will also be noted. The logbook will be reviewed several times during each week to determine samples scheduled for disposal. On or soon after the scheduled disposal date, the samples will be removed from archive storage and disposed.

In consideration of disposal requirements for hazardous samples, each sample processed by the laboratory will be evaluated for contamination levels based on final analytical results. Those samples containing analytes of interest at or above regulated disposal levels will be identified and handled as hazardous waste. A designated staff member coordinates periodic pickup and disposal of hazardous waste by an USEPA approved TSD (Treatment, Storage, and Disposal) Company and maintains hazardous waste disposal records. Specific guidelines for handling hazardous samples and waste are detailed in the Chemical Hygiene Plan (Section 5, Waste Disposal Procedures)

SECTION 7: PROJECT MANAGEMENT AND TRACKING

7.1 Project Management

Concise and accurate communication between a client and ARI, and within the laboratory, is an extremely important requirement for generating quality analytical results. All clients contracting with ARI will be assigned to a Project Manager. The Project Manager confirms that project requirements are consistent with laboratory capabilities, and coordinates with laboratory sections to provide analytical results within specified project timelines. Project organization, monitoring, and follow-up is the responsibility of Project Management staff.

Client project requirements and Project Managers' areas of expertise will be considered for client assignment. To ensure that all clients and projects receive the attention necessary for successful project completion, Project Manager workloads will also be considered. Project Managers will serve as the central focus for all project related activities and communications.

The Project Manager will review work plans and requirements for all pending projects. Any questions related to the work plan will be addressed prior to project commencement. The Project Manager will consult with appropriate analytical sections to clarify any issues regarding procedures and capabilities. Project deliverables requirements will also be addressed at this time. Upon receipt and log-in of project samples, the Project Manager will review all documentation to ensure that samples were properly logged in, and that analytical and QC requirements were correctly specified. The Project Manager will also provide any additional project related information that will assist the analytical sections with sample analysis. Laboratory sections will not process a sample until Project Manager approval has been given. Exceptions are parameters with critical (less than 48 hour) holding times or those that arrive on weekends or holidays when none of the Project Managers can be contacted.

Throughout the project, the Project Manager will monitor all analytical activities to help ensure that the project is completed and delivered on schedule. Any issues arising during sample processing will be promptly discussed with the client. Likewise, the analytical staff will be informed of any client concerns or project modifications. The Project Manager will also address any issues that arise during subsequent review of the analytical data by the client.

7.2 Project Tracking

Monitoring the laboratory workload ensures that adequate staffing and equipment will be available to produce quality analytical data and meet client needs. At the time a client project is tentatively scheduled, information regarding the project will be documented in the Project Management Database. Project particulars, sample quantities, parameters and anticipated sample delivery dates will be specified, as well as any prearranged analytical costs. Project work plans and any other project information will be kept on file with the Project Manager. Schedules for pending projects are communicated to the lab sections through periodic distribution of database printouts. Upon receipt of project samples, the project Inquiry number will be referenced to ensure project requirements are accurately specified. The original project documentation will be placed in the master folder as part of the project file.

Each laboratory section analyzing project samples will be responsible for ensuring that all analyses are accurately completed by the required date. All staff members are required to be aware of holding times, special analytical requirements, and required turnaround times. Analytical sections will remain in close communication with the Project Management staff so that any issues arising during sample analysis can be promptly addressed or discussed with the client.

Project Managers or their designee are responsible for monitoring project status. Sample status reports are generated as needed from LIMS and are distributed to lab sections and Project Managers. These reports allow the Project Managers to review project status and identify any samples which must be expedited to meet project timelines. Additionally, verbal communication between Project Managers and lab sections provides information about project status.

After sample analysis, report generation, and final review have been completed, data and final reports will be forwarded to the Project Manager. If requested, preliminary and interim results will be forwarded to the client. When all final data are available, the Project Manager will assemble the final package, verifying that all analyses were completed and project requirements met. A project narrative detailing the particulars of sample processing will be generated. After assembly and prior to shipment, the Project Manager will perform a final, cursory review of the package for any inconsistencies or incorrect information. The package will then be forwarded to clerical personnel for photocopying and shipment.

The Project Manager will determine final analytical costs and submit this information to the Accounting department for invoicing. Upon completion, all raw data and documentation associated with each client project will be compiled and stored as part of the laboratory project files. A chart detailing laboratory workflow as described in this section is included as Appendix G.

SECTION 8: ANALYTICAL METHODS

To ensure that all data generated are consistent and comparable, clearly defined procedures will be followed for all aspects of sample processing, control and management. Standard Operating Procedures (SOPs) provide detailed guidelines for completing a procedure. Document control procedures and periodic audits will ensure that operations are performed in accordance with the most current SOPs. All routine deviations from published will be noted in the SOPs. Analysis specific deviation will be noted in Analyst Notes and in the Analytical Narrative.

8.1 Responsibilities

It is the responsibility of staff members to perform all procedures in accordance with the guidelines specified in the Standard Operating Procedures. Laboratory management is responsible for ensuring that SOPs are followed throughout the laboratory. The QAPM is responsible for coordinating periodic review and revision of existing SOPs and generation of additional SOPs. The QAPM is also responsible for maintaining SOP document control and ensuring that the most current versions of all SOPs are available to staff members.

8.2 Methods

Laboratory procedures may reference any established methods specified in the following publications:

1. *Code of Federal Regulations (Section 40)*
2. *Test Methods for Evaluating Solid Waste (USEPA SW-846)*
3. *USEPA Contract Laboratory Program Statement of Work for Organic Analysis*
4. *USEPA Contract Laboratory Program Statement of Work for Inorganic Analysis*
5. *Methods for Chemical Analysis of Water and Waste (USEPA 500 and 600 series)*
6. *Standard Methods for the Examination of Water and Wastewater*
7. *Protocols for Measuring Selected Environmental Variables in Puget Sound (PSEP)*
8. *Navy Installation Restoration Laboratory Quality Assurance Guide(February 1996)*
9. *Hazardous Waste Remedial Actions Program (HAZWRAP)*
10. *State of Alaska Department of Environmental Conservation (ADEC)*
11. *Oregon Department of Environmental Quality (DEQ) Petroleum Hydrocarbon Methods*
12. *Washington Department of Ecology (WA-Ecology) Guidance for Remediation of Releases from Underground Storage Tanks (Appendix L)*
13. *The Department of Defense Quality Systems Manual (DoD-QSM)*
14. *Washington State Sediment Sampling and Analysis Plan*

The laboratory will adhere to established methods whenever possible. Occasionally, however, procedures determined to provide more accurate final results will be incorporated into the method. Should the laboratory procedures deviate from the established method, all modifications will be detailed in the associated SOP. A listing of laboratory SOPs is included as Appendix E.

8.3 Standard Operating Procedures

Standard Operating Procedures (SOPs) are detailed, step-by-step instructions for completing a laboratory operation. An SOP is available for all procedures within the laboratory, from initial project identification to final data archival. SOPs are generated for procedures developed within the laboratory and for those that follow established methods.

To ensure consistency in defining procedural guidelines, all SOPs that describe analytical procedures will contain the following sections:

1) Method, matrix or matrices, detection limit, scope & application, components to be analyzed
2) Summary of the test method
3) Definitions
4) Interferences
5) Safety
6) Equipment and supplies
7) Reagents and standards
8) Sample collection, preservation, shipment and storage
9) Quality control
10) Calibration and standardization
11) Procedure
12) Data analysis and calculations
13) Method performance
14) Pollution prevention
15) Data assessment and acceptance criteria for quality control measures
16) Corrective actions for out of control data
17) Contingencies for handling out-of-control or unacceptable data
18) Waste management
19) References
20) Appendices, tables, diagrams, flowcharts and validation data.

SOPs will be monitored through the laboratory document control system. Each SOP will be assigned a document control number as detailed in Section 5.2 of this LQAP. SOPs are revised whenever a laboratory procedure is changed or modified. All SOPs are reviewed and revised as necessary at least once a year. Personnel normally performing the procedure or analysis perform the review. SOPs will be generated for each new procedure implemented within the laboratory. Review, modification, new SOP generation, and distribution will be coordinated through the QAPM. The QAPM will periodically audit the laboratory sections to verify that the most current versions of all SOPs are in use. Document release will be controlled as detailed in section 5.2.

8.4 Method Selection and Use

Method selection will be based on availability of analytical instruments and equipment, chemical standards, expected method performance and marketability. Methods that are defined and accepted by regulatory agencies and familiar to ARI's clients are preferred. The Laboratory Manager and QAPM in consultation with marketing, client service, and laboratory supervisory staff are responsible for selecting appropriate methods. Client or project-specific methods may be used when appropriate.

The most recently promulgated method will be used for all procedures. Non-promulgated methods will be investigated if requested by a client. Section supervisors and managers are responsible for ensuring that the procedures in use reflect the requirements of the promulgated methods. Any modifications made to the method must be documented in the SOPs. Method modifications may be acceptable, provided all acceptance criteria specified in the method are met.

Section supervisors and managers review newly promulgated methods. SOPs will be modified as necessary to reflect the new methods. When possible, the annual SOP review will be coordinated with anticipated method promulgation dates. This is especially useful for large method compilations, such as SW-846. If the annual SOP review and method promulgation cannot be coordinated, SOPs will be revised as soon as possible after a method has been promulgated, especially when method changes are significant.

SOPs will be generated to reflect the most commonly used methods and protocols. If more than one method is used for an analysis, separate SOPs should be generated. Several methods may be incorporated into one SOP, provided that each method is clearly identified and defined in the SOP. Method modifications or special requirements for ongoing projects, or for specific programs (Navy, CLP, etc.), will be incorporated into the SOP. These requirements will be annotated to indicate that they are project/program specific. Analysts and technicians will be responsible for ensuring that, when required, project or program specific procedures are followed. SOPs will be controlled as specified in section 5.2.

8.5 Method Performance

Method performance must be demonstrated for all new methods prior to using methods for sample analysis. Section supervisors and managers are responsible for ensuring that method performance is demonstrated and support procedures have been performed.

Method performance will be demonstrated in the following manner:

A draft SOP will be generated for the method. The SOP must provide sufficient detail to perform the analysis and must accurately reflect the published method. Any steps in the method for which analyst discretion is allowed must be clearly defined.

A method detection limit (MDL) study must be performed for the method. Method detection limits must be verified to be at or lower than any method-specified detection limits. Method detection and reporting limits must be established.

Method precision and accuracy must be evaluated. This may be determined using an MDL or IDL study. Replicates will be evaluated for precision; analyte values will be compared with spike amounts to determine accuracy. Any method-specified precision and accuracy criteria must be met.

All method performance results will be reviewed and compiled by the section supervisor. Results will be filed with the QA section. A final SOP will be generated and distributed. MDL updates will be communicated to Computer Services for LIMS updates and distributed to laboratory sections as needed.

SECTION 9: INSTRUMENT CONTROL

9.1 Detection Limits

To verify that reported limits are within instrument and method capabilities, three levels of detection have been established: instrument detection limits, method detection limits, and reporting limits. Instrument and method detection limits are statistically based values, determined from replicate analyses of analytical standards. Reporting limits are based upon the experience and judgment of an analyst. Reported values will be qualified based on the established limits. All limits will be summarized and controlled by the QAPM and are included as Appendix I.

Instrument Detection Limits

The instrument detection limit (IDL) is considered to be the smallest signal above background noise that an instrument can reliably detect. This limit reflects whether or not the observed signal has been caused by a real signal or is only a random fluctuation of noise from the blank. The IDL does not take into consideration the performance or efficiency of analytical methods.

Instrument detection limits are determined annually, or when ever a major change has been made, for each instrument in the metals analysis laboratory. Seven replicates, of a blank, or standards containing analytes at levels three to five times the expected IDLs are analyzed on three non-consecutive days. The IDL value for an analyte is three times the average of the standard deviations from the three replicate sets of analyses.

Method Detection Limits

The method detection limit (MDL) is considered to be the lowest concentration of an analyte that a method can detect with 99% confidence. Method detection limits will be established for all analytical parameters according to the guidelines specified in the Code of Federal Regulations, Section 40. Seven replicate samples are fortified with target analytes at levels that are one to five times (but not exceeding 10 times) the expected detection limits. The MDL for an analyte is determined to be the standard deviation of the replicates times the appropriate student's t-test value. More than seven replicates may be processed, but all replicates must be used in the MDL determination. MDLs are verified by analyzing a sample spiked at a concentration 3 to 5 times the calculated MDL concentration. When the analyte(s) are detected the MDL is verified. When the analytes is not detected, the concentration in the verification sample is increased until it is detected. The concentration at which the analytes is first detected then becomes the MDL.

Laboratory supervisors or managers review all statistically determined MDLs for accuracy and validity. The section supervisor or manager is responsible for ensuring that any unusable MDL studies are reprocessed. Once accepted, MDL study results and associated raw data will be forwarded to the QA section for further review and additional approval. MDLs approved by both section management and QA will be considered final and acceptable for use. Finalized MDL values are forwarded to Computer Services for incorporation into ARI's LIMS.

MDL studies will be conducted for all analyses performed by the laboratory on representative water, sediment and, tissue samples when appropriate and suitable sample matrices are available. MDL studies will be performed on all instruments used for sample analysis. To allow for reevaluation of method performance, MDL studies will be performed on an annual basis. The QAPM is responsible for ensuring that all MDL studies are performed at least annually. Section supervisors and managers are responsible for determining if and when additional MDL studies should be performed due to changes in analytical methods, instrumentation or personnel.

Reporting Limits

Reporting Limits (RL) are the lowest quantitative value routinely reported. Analytical results below the RL will be expressed as "less than" the reporting limit. RLs are estimated values based upon the MDLs, experience and judgment of the analyst, method efficiency, and analyte sensitivity. No reporting limit will be lower than its corresponding MDL. RLs will be verified on a regular basis either by having a calibration standard at the limit or by analyzing a standard at the RL immediately following initial calibration.

Analytical Standards

Generation of high quality results is dependent upon the use of accurately prepared analytical standards. Many stock standards used within the laboratory are commercially prepared solutions with certified analyte concentrations. Neat standards used for stock standard preparation are of the highest purity obtainable. Standard preparations are fully documented in appropriate logbooks.

Responsibilities

It is the responsibility of each laboratory employee involved with standards preparation to ensure that all standards are correctly and accurately prepared through the use of good laboratory practices and analytical verification. It is also the responsibility of these staff members to properly document the receipt and/or preparation of all standards. Management is responsible for ensuring that all staff members follow specified standards preparation and inventory procedures. The QAPM is responsible for periodically auditing standard preparation records to verify compliance with the laboratory Quality Assurance Program.

Organic Standards Preparation

Two types of standards are utilized for extractable organic compounds: neat standards from which stock solutions are prepared, and commercially prepared stock solutions from which working solutions are prepared. The type of standard depends upon availability. Commercially prepared standards are preferred when available.

Preparation of stock solutions will be documented in the Stock Solutions Log. To ensure traceability, commercially prepared stock solutions will also be documented in the Stock Standard Solutions Log. Each solution will be assigned a unique stock number determined by the page number and entry number on the page, preceded by “S” to indicate the solution is a stock, volatile stock standard are labeled “VS”. For example, the third entry on page 44 will be assigned the stock number S44-3. For stock solutions prepared from neat standards, the compound(s), supplier, lot number, preparation schematic, preparation date, expiration date, and analyst initials will be recorded. After preparing the standard, another analyst should review the preparation information to verify accuracy. For commercially prepared stock solutions, the compound, supplier, lot number and expiration date will be recorded. As a stock solution is not actually prepared in-house for these commercial solutions, it is not necessary to record or verify a preparation schematic.

Preparation of working solutions (including spike and surrogate solutions) will be documented in the Working Standard Solutions Logbook. Each solution will be assigned a working standard number determined by the page number and entry number on the page. For example, the second entry on page 73 will be assigned the working standard number 73-2. For volatile organic standards, the working standard number is preceded by “VW”. The compound, stock solution reference, preparation schematic, preparation date, expiration date, and analyst initials will be recorded. After preparing the standard, another analyst will review the preparation information to verify accuracy. After analyzing the standard and confirming that it is acceptable, analytical verification will be documented in the logbook.

Discarded or consumed standards will be annotated in the logbook by drawing a single line through the entry, indicating “discarded” or “consumed” above the line with confirming initial and date. Existing standard numbers will not be reused. Instead, each new stock or working solution made will be assigned a new number.

Standards preparation will be performed in accordance with good laboratory practices. Syringes, glassware and other preparation equipment will be thoroughly cleaned prior to and after use. Standard material weights and solution volumes will be accurate to ± 3%. Neat standards that are less than 97% pure must be corrected for concentration. Standard solutions will be stored in amber bottles with Teflon-lined caps. Each standard solution will be labeled with the solution number, compound, analyst initials and expiration date. Stock solutions will be stored in the appropriate standards freezer; working solutions will be stored in the appropriate standards refrigerator.

Metals Standard Preparation

Commercially prepared single element stock solutions are used for all elements. Preparation of working solutions from these single element stocks will be documented in the Solutions Logbook. Preparation of check standards will also be documented in the Solutions Logbook. The element, preparation schematic, preparation date, expiration date, and analyst initials will be recorded. Working calibration standards are prepared weekly for furnace and ICP analyses and as needed for ICP-MS. Calibration verification standards are prepared daily for GFA analyses and as needed for ICP and ICP-MS analyses.

Standards preparation will be performed in accordance with good laboratory practices. All preparation equipment will be thoroughly cleaned prior to and after use.

Inorganic (Wet Chemistry) Standard Preparation

Working standards for wet chemistry parameters will be prepared on a daily basis, prior to starting an analysis. Stock and check standard solutions will be replaced as solutions expire or are consumed. Stock and check standard solutions will be labeled with the compound, preparation data (weight and volume), units of concentration, preparation date, expiration date, and analyst initials.

Standards preparation will be performed in accordance with good laboratory practices. Glassware and other preparation equipment will be thoroughly cleaned prior to and after use. Standard material weights and solution volumes will be accurate to ± 3%. Stock standards will be stored in containers appropriate for the parameter.

9.3 Calibration

Instrumentation and equipment used for sample processing and analysis must be operating optimally to ensure that accurate analytical results are generated. Verification of optimum operation is accomplished through various tuning and calibration procedures. Criteria for determining the accuracy of calibration are specified for all instrumentation and equipment. Prior to sample analysis, calibrations will be analyzed and evaluated against specified acceptance criteria. Acceptance criteria are either published as part of the method or generated at ARI using control charts. Calibration verifications will also be analyzed throughout an analytical sequence to ensure that instrument performance continues to meet acceptance criteria.

Gas Chromatography/Mass Spectrometry (GC/MS)

All GC/MS systems will be evaluated through analysis of an instrument performance check solution and calibration standards. The composition of the standards varies depending on the analysis performed on the system. System evaluation will be performed prior to sample analysis. Evaluation criteria used for GC/MS analyses are as specified for the SW846 methods.

Instrument Performance Check Solution - Prior to analysis, the system will be evaluated to ensure that mass spectral ion abundance criteria are met. Bromofluorobenzene (BFB) is analyzed for volatile organic analyses and Decafluorotriphenylphosphine (DFTPP) is analyzed for semi-volatile organic analyses. All ions must meet method-specified criteria.

The instrument performance check solution will be analyzed at a minimum of every 12 hours during the analytical sequence. Each analysis of the check solution will be verified against the specified criteria.

Calibration - After instrument performance has been verified, each GC/MS system will be calibrated to verify response linearity. For volatile organic analyses, up to eight standards ranging from 1 to 200 µg/L will be analyzed. For semi-volatile organic analyses, five to seven standards ranging from 2 to 80 µg/L will be analyzed. The standard levels evaluated will vary depending on the compound. Initial calibration results will meet percent relative standard deviation acceptance criteria.

A continuing calibration verification standard at a mid-level concentration (routinely 50 µg/L for VOA and 250 µg/L for SVOA) will be analyzed at a minimum of every 12 hours during the analytical sequence. For continuing calibrations, minimum response factor and percent difference criteria will be considered in evaluating the acceptability of the calibration. Initial and continuing calibration acceptance criteria for volatile and semi-volatile organic analyses are presented in Appendix J. All calibration data printouts will include the following documentation:

Date of calibration,
Identification of standard used
Identification of person performing the calibration

The analyst performing the calibration will include documentation of any problems encountered during the calibration analyses with the data, and will also note any corrective actions taken. The calibration data will be tabulated, and summary statistics will be generated. These results will be kept on file with the raw data in the Data Services section.

Internal Standard Responses - Internal standard responses and retention times in all standards will be evaluated immediately after analysis. This will serve as a baseline from which all sample internal standard responses and retention times will be evaluated.

Gas Chromatography (GC)

Each GC and HPLC system will be calibrated to verify response linearity. Depending on the parameter, five to seven standards at concentrations covering the linear range of the instrument will be analyzed. Percent relative standard deviations for initial calibrations will not exceed SW-846 limits or 25% when those limits are not applicable.

A continuing calibration standard at mid-range concentration will be analyzed after every 10 samples or more frequently if the method or conditions warrant. Percent differences between initial and continuing calibrations will not exceed SW-846 limits or 25% when those limits are not applicable.

Calibration for organochlorine pesticides will follow SW-846 guidelines. The initial calibration sequence specifies the analysis of Resolution Check, Performance Evaluation, five-point initial calibration, individual standards and instrument blanks. Criteria for evaluating these standards are as follows:

> Performance Evaluation - The Performance Evaluation standard will be analyzed immediately following the Resolution Check standard. All standard peaks will be completely resolved. Individual breakdowns of DDT and Endrin will be less than or equal to 15% on both columns. A Performance Evaluation standard will also be analyzed at the end of the calibration sequence.
>
> Initial Calibration - The percent relative standard deviation (RSD) will not exceed SW-846 guidelines or 20% on each column.
>
> Continuing Calibration - A midpoint Aroclor 1660 and or a midpoint pesticide standard along with a performance evaluation standard are analyzed after every ten (10) sample analyses. The continuing calibration standards will be within 85 - 115% of the initial calibration. The Performance Evaluation standard will meet previously specified criteria.

The analytical sequence may continue indefinitely, provided that calibration criteria are met throughout the sequence. Additionally, retention times for all compounds will fall within the retention time windows established by the initial calibration sequence of the three standard concentration levels.

All calibration data printouts will include the following documentation:

> *Date of calibration,*
> *Identification of standard used, and*
> *Identification of person performing the calibration.*

The analyst performing the calibration will include documentation of any problems encountered during the calibration analyses with the data, and will note any corrective actions taken. The calibration data will be tabulated, and summary statistics will be generated.

Metals

Analytical instrumentation for metals will be evaluated through the analysis of calibration standards, calibration blanks, and calibration verification standards. Initial calibrations will be performed prior to sample analysis.

Inductively Coupled Plasma Atomic Emission Spectrometry (ICP)

Initial standardization is performed daily, or more frequently as required, by analyzing a blank and four multiple element standards with a single concentration for each analytical wavelength. The calibration is immediately verified with the analysis of an initial calibration verification standard (ICV) obtained from a source independent from the IC standard. The calibration will then be verified throughout the analytical sequence by analyzing a continuing calibration verification standard (CCV) after every 10 sample analyses. The calibration check standard values will be within ± 10% of the true value.

After initial calibration, a calibration blank (ICB) will be analyzed to check for baseline drift or carryover. The level of analyte in the calibration blank should be ±2 RL. Calibration blanks (CCB) will be analyzed immediately following each calibration verification standard analysis.

Following calibration verification a standard at the reporting limit (CRI) is analyzed for all elements. Warning limits have been set at ±1RL and any sample determined to have a concentration below this standard will be reported as undetected.

The upper limit of the calibration range, linear dynamic range, is established for each analytical wavelength using standards of increasing concentrations. These standards are analyzed against the normal calibration curve and must be within 10% of their true value to verify linearity. At a minimum this upper range will be checked every six months or whenever major changes are made to the instrument. Any sample analyzed with a concentration above this linear dynamic range will be diluted and reanalyzed.

Also to verify the inter-element correction equations, inter-element correction standards (ICS) are analyzed both at the start and end of the analytic run. Both the major interfering and the interfered with elements are evaluated.

Atomic Absorption Spectroscopy (Graphite Furnace and Cold Vapor)

Atomic absorption instrumentation is initially calibrated using a minimum of three standards of varying concentrations and a calibration blank. Initial calibration is performed daily or more frequently if conditions warrant. The calibration is immediately verified with the analysis of an independent source initial calibration verification standard (ICV). The calibration will then be verified throughout the analytical sequence by analyzing a continuing calibration verification standard (CCV) after every 10 sample analyses. The initial calibration verification standard value will be within ± 10% of the true value whereas the CCV will be considered in control if it is within ±10% for Graphite Furnace analysis or ±20% for Cold Vapor analysis.

After initial calibration, a calibration blank (ICB) will be analyzed to check for baseline drift or carryover. The level of analyte detected in the calibration blank should be ±1 RL. Calibration blanks (CCB) will be analyzed immediately following each calibration verification standard analysis.

Following calibration verification a standard at the reporting limit is analyzed for all elements. Warning limits have been set at ±1RL and any sample determined to have a concentration below this standard will be reported as undetected. Any sample determined to have a concentration above the high calibration standard will be diluted and reanalyzed.

Inductively Coupled Plasma Mass Spectrometry (ICP-MS)

Initial standardization is performed daily, or more frequently as required, by analyzing a blank and four multiple element standards. The calibration is immediately verified with the analysis of an independent source initial calibration verification standard (ICV). The calibration will then be verified throughout the analytical sequence by analyzing a continuing calibration verification standard (CCV) after every 10 sample analyses. The calibration check standard values will be within ± 10% of the true value.

After initial calibration, a calibration blank (ICB) will be analyzed to check for baseline drift or carryover. The level of analyte in the calibration blank should be ±1 RL. Calibration blanks (CCB) will be analyzed immediately following each calibration verification standard analysis.

Following calibration verification a standard at the reporting limit (CRI) is analyzed for all elements. Warning limits have been set at ±1RL and any sample determined to have a concentration below this standard will be reported as undetected.

The upper limit of the calibration range, linear dynamic range, is established for each analytical wavelength using high level standards. These standards are analyzed daily, or as necessary, against the normal calibration curve and must be within 10% of their true value to verify linearity. Any sample analyzed with a concentration above this linear dynamic range will be diluted and reanalyzed.

Also to verify the inter-element correction equations, inter-element correction standards (ICS) are analyzed both at the start and end of the analytic run. Both the major interfering and the interfered with elements are evaluated.

Inorganic Analyses other than Metals (Conventional Analyses)

Instrumentation and equipment used in analyzing samples for conventional wet chemical parameters (predominantly inorganic anions and aggregate organic characteristics) will be evaluated through the analysis of either internally prepared primary standards or externally derived Standard Reference Materials.

Depending upon the analysis, calibration is based upon direct stoichiometric relationships, regression analysis, or a combination of the two. Stoichiometry generally involves standardization of a titrant against a known primary standard and then the use of that titrant for determining the concentration of an unknown analyte (e.g. the use of sodium thiosulfate in the iodometric titration of dissolved oxygen). Regression analysis involves the determination of the mathematical relationship between analyte concentration and the response produced by the measurement being employed. Regression analysis is used for colorimetric determinations, ion specific electrode analysis and ion chromatography. The curve of response versus concentration is fit by the method of least squares using linear, polynomial or logarithmic regression dependant upon the pattern of response being measured.

Calibration is repeated for each analytical batch. Immediately following calibration, the standardized titrant or the calibration curve will be verified by the analysis of an Initial Calibration Verification standard (ICV) and Initial Calibration Verification Blank (ICB). The verification standard will be derived from a source other than that used for standardization or development of the standard curve. The ICV must return a value within 10% of its known concentration. The ICB must be less than the Reporting Limit (RL) or the lowest point on the standard curve, whichever is less. Initial calibration verification must be successfully completed prior to the analysis of any samples.

Calibration verification will be repeated after every ten samples processed during an analytical run. This Continuing Calibration Verification (CCV) will validate the method performance through an analytical sequence. If the continuing calibration values for either the standard or blank are out-of-control, the analyst will verify the outlying condition and, if verified, the analysis will stop and the method will be re-calibrated. All samples run between the outlying

CCV and the preceding in-control CCV will be re-analyzed. In-control verification standards and blanks must bracket all samples within an analytical run.

Initial calibration depending upon the analysis is based on a direct stoichiometric relationship, a linear regression analysis or a combination of the two. Stoichiometry generally involves standardization of a titrant and use of that titrant for determining the concentration of an unknown analyte (e.g. the use of thiosulfate in iodometric determination of dissolved oxygen). Regression analysis involves the determination of the mathematical relationship between the analyte concentration and the response produced by the measurement being employed. The curve is fit by the method of least squares using a linear, polynomial or logarithmic regression depending on the response being measured. The regression coefficient will be greater than or equal to 0.995 for the calibration to be considered acceptable.

Initial calibration curve is verified throughout the analytical sequence by analyzing a calibration verification standard after every 10 sample analyses. The calibration verification standard value will be within $\pm$ 10% of the initial calibration.

After initial calibration, a calibration blank will be analyzed to determine target analyte concentration levels. The level of analyte detected in the calibration blank will be less than the lowest standard concentration in the initial calibration.

SECTION 10: DATA VALIDATION and REVIEW

One hundred percent (100%) of laboratory data generated at ARI are subjected to a four level validation (review) process prior to release from the laboratory. The four levels of review are:

1. Analyst review
2. Peer review
3. Supervisory review
4. Administrative review

The data review process is outlined below and detailed in SOPs 200S through 206S.

In addition, Quality Assurance Personnel review 10% or more of all completed data packages for technical accuracy, project compliance and completeness. The data validation outlined below is completed in addition to the initial project review explained in Section 7 and QA specific reviews outlined in Section 11. If it is determined at any point during the analysis, reporting, or review process that data are unacceptable, prompt and appropriate corrective action must be taken. The corrective action will be determined by the situation. It is the responsibility of all staff members involved in data reporting and review to be aware of the quality control requirements and to be able to identify occurrences that require corrective action.

Analyst review:

Each analyst is responsible for producing quality data that meets ARI′s established requirements for precision and accuracy and is consistent with a client's expectation.

Prior to sample preparation or analysis an analyst will verify that:

1. Sample holding time has not expired.
2. The condition of the sample or extract is described accurately on the laboratory bench sheet.

3. Specified methods of analysis are appropriate and will meet project required Data Quality Objectives.
4. Equipment and Instrumentation are in proper operating condition.
5. Instrument calibration and/or calibration verification are in control.

During sample preparation or analysis an analyst will:

1. Verify that Method Blanks and Laboratory Control Samples are in control.
2. Verify that QC (replicate, matrix spike analyses, SRM, etc.) samples meet precision and accuracy requirements.
3. In addition to verifying that quality control requirements are met, the analyst will review each sample to determine if any compound of interest is present at levels above the calibrated range of the instrument.
5. Check for data translation or transcription errors
6. Record all details of the analysis in the appropriate bench sheet or logbook.
7. Note any unusual circumstances encountered.

Following the analysis or sample preparation an analyst will:

1. Examine each sample and blank to identify possible false positive or false negative results.
2. Determine whether any sample requires reanalysis due to unacceptable quality control.
3. Review data for any unusual observances that may compromise the quality of the data, such as matrix interference
4. Review and verify that data entry and calculations are accurate and no transcription errors have occurred.
5. Document anomalous results or other analytical concerns on the bench sheet, corrective action form or Analyst Notes for incorporation into the case narrative.
6. Note data with qualifying flags as necessary.

7. Enter reviewed data into LIMS as appropriate, incorporate all necessary sample and quality control information into the data package and forward it for further review.

Peer review:

A second analyst trained in the appropriate SOPs will complete a peer review. Peer review will include at a minimum:

1. Verification that all QA (holding times, calibrations, method blanks, LCS, spiked sample analyses, etc.) criteria are in control.
2. Examination the data for possible calculation and transcription errors.
3. Review bench sheets and analyst notes for completeness and clarity.
4. Approve the analytical results or recommend corrective action to the laboratory supervisor.

When a second trained analyst is not available a peer review is not completed.

Supervisory Review:

Following analyst and peer review the data is forwarded to the laboratory section supervisor for review. The supervisor will:

1. Review the data package for completeness and clarity.
2. Follow-up on the peer review recommendations.

Designated reviewers normally perform the peer and supervisory reviews for GC-MS data. The reviewers are identified on the organizational chart in Appendix A.

Administrative Review:

The results of all analyses are reviewed for compliance with quality control criteria and technical correctness before data is released to the Project Manager for distribution to clients. Designated reviewers in the Metals, Conventional and Organic laboratories perform administrative reviews. Personnel responsible for administrative reviews are noted in the Organizational Chart in Appendix A to this LQAP.

Administrative review is the final data validation process. Personnel performing the administrative review are responsible for the final sign-off and release of the data. Following administrative review the data is released to Project Managers for incorporation into the final data deliverable package.

Administrative review will:

1. Verify that the analytical package submitted for reporting is complete and contains all necessary information and documentation.
2. Verify that appropriate and necessary data qualifying flags (Listed in Appendix N) have been used.
3. Verify that method blank and LCS data are acceptable, quality control requirements were met for surrogates in all samples and blanks, and that all necessary re-analyses or dilutions were performed.
4. Check the technical validity (i.e. are total metal ≥ dissolved metals, is the cation/anion balance correct, etc.) of the complete data set.
5. Verify that all necessary final data reports have been generated and that all necessary data and documentation are included in the package.
6. Approve data reports for release.

10.2 Quality Assurance Review

10% (1 out each 10) final data packages are reviewed by ARI′s QA staff for compliance with ARI′s QA Program. This assessment includes, but is not limited to, review of the following areas:

1. Reporting and analysis requirements
2. Initial and continuing calibration records
3. Quality control sample results (method blank, LCS, spikes, replicates, reference materials)
4. Internal and surrogate standard results
5. Detection and reporting limits
6. Analyte identifications.

Data review activities are summarized and documented by the reviewer. The review notes are filed with the associated raw data in the project file. Any QA-related deficiencies identified during the data review will be forwarded to the QAPM for corrective action.

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SECTION 11: QUALITY CONTROL SAMPLE ANALYSIS AND EVALUATION

Routine analysis of quality control (QC) samples is necessary to validate the quality of data produced in ARI's laboratory. ARI routinely utilizes the following quality control analyses as defined in Section 11.3:

1. method blank (MB)
2. holding blank (HB)
3. surrogate standard analyses (SS)
4. laboratory control sample (LCS)
5. laboratory control sample duplicate (LCSD)
6. standardized reference material (SRM)
7. sample(matrix) replicate (MD)

8 matrix spike (MS)

9. matrix spike duplicate (MSD)

The number and type of QC analyses depend on the analytical method and/or the QA/QC protocol required for a specific project. A range of acceptable result is defined for each type of QC analysis. When all quality control sample results are acceptable, the analysis is considered to be "in-control" and the data suitable for its intended use. Conversely, quality control sample results that do not meet the specified acceptance criteria indicate that the procedure may not be generating acceptable data and corrective action may be necessary to bring the process back "in-control".

Detailed information concerning sample preparation batches, QC analyses and surrogate standards follow:

11.1 Sample Preparation Batch

All QC samples will be associated with a discrete sample preparation batch. A preparation batch is defined as 20 or fewer field samples of similar matrix processed together by the same analysts, at the same time, following the same method and using the same lot of reagents. Additional batch requirements are detailed in ARI's method specific standard operating procedures. Each preparation batch will be uniquely identified. All samples, field and QC, will be assigned an ARI LIMS ID number and will be linked to their respective preparation batch. Each sample batch will contain all required QC samples in addition to a maximum of twenty field samples.

ARI will accommodate client, QC protocol or QAPP specific sample batching schemes.

11.2 QC Sample Requirements

Each preparation batch will include, at a minimum, a method blank (MB) and a laboratory control sample (LCS). Additional QC samples will be analyzed based upon the specific QC protocol required, data deliverable requirements or client request. ARI recommends that QC samples used to measure analytical precision also be included in each sample batch. These may include: a matrix spike and a matrix spike duplicate pair; a sample duplicate and a matrix spike pair or an LCS duplicate (LCSD) for comparison with the LCS.

11.3 QC Sample Definitions

11.3.1 Method Blank (MB)

A method blank is an aliquot of water or solid sample matrix that is free of target analytes and is processed as part of a sample batch. The method blank is used to verify that contaminants or compounds of interest are not introduced into samples during laboratory processing. Method blanks will be spiked with surrogate standards for all organic analyses.

ARI defines an acceptable method blank as one that contains no target analytes at a concentration greater than one-half ARI's reporting limit or 5% of an appropriate regulatory limit or 10% of the analyte concentration in the sample which ever is greatest.

A minimum of one method blank will be included in each preparation batch. A maximum of twenty samples may be associated with one method blank. An acceptable method blank is required prior to analysis of field samples from a preparation batch. For methods not requiring pre-analysis sample preparation, a minimum of one method blank will be analyzed immediately prior to sample analysis, periodically throughout the analytical sequence, and also at the end of the sequence.

The results of the method blank analysis will be reported with the sample results.

11.3.2 Holding Blank (HB)

Holding blanks are organic-free water samples that are placed in each volatile organic sample storage refrigerator to monitor for possible cross-contamination of samples within the storage units. A holding blank from each refrigerator will be analyzed every 14 days. Holding Blank analyses will be reviewed by laboratory management and archived in ARI's electronic document archive.

11.3.3 Laboratory Control Sample (LCS)

An LCS is processed as part of each preparation batch, and is used to determine method efficiency. An LCS is an aliquot of water or solid matrix free of target analytes to which selected target analytes are added in known quantities. The analytes spiked into LCS samples are listed in ARI's method specific SOPs. LCS will be spiked with surrogate standards for all organic analyses.

Following analysis the percent recovery of each added analyte is calculated and compared to historical control limits. Current control limits are listed in Appendix K of this document. When calculated recovery values for all spiked analytes are within specified limits, the analytical process is considered to be in control. Any recovery value not within specified limits requires corrective action prior to analysis of any field samples from the associated preparation batch.

A minimum of one LCS will be prepared for each sample preparation batch. LCS analysis for those methods not requiring pre-analysis sample preparation will be performed after each continuing calibration. The results of all LCS performed will be reported with the sample results. A maximum of twenty samples may be associated with one LCS.

Specific clients or QA protocol may require the analysis of a duplicate LCS. When LCS duplicates are analyzed the failure of any analyte in either LCS to meet QC limits must trigger a corrective action.

11.3.4 Replicate Analysis

Replicate analyses are often used to determine method precision. Replicates are two or more identical analyses performed on subsamples of the same field sample at the same time. Replicate analyses should be performed on samples that are expected to contain measurable concentrations of target analytes.

The calculated percent difference between replicates must be within specified limits or corrective actions are required. Percent differences exceeding the specified limit signal the need for procedure evaluation unless the excessive difference between the replicate samples is clearly matrix related.

For inorganic analyses, a minimum of one replicate set should be processed for each analytical batch. Replicate sample analyses are not routinely performed for organic parameters. Instead, analytical precision is evaluated through the analysis of a duplicate matrix spike sample (MSD).

In order to perform replicate analyses, ARI's must receive sufficient volume to prepare the replicate aliquots.

Field replicates submitted to the laboratory will be analyzed as discrete samples.

11.3.5 Matrix Spike

A matrix spike is an environmental sample to which known quantities of selected target analytes have been added. The matrix spike is processed as part of an analytical batch and is used to measure the efficiency and accuracy of the analytical process for a particular sample matrix. The analytes spiked into MS samples are listed in ARI's method specific SOPs. MS samples will be spiked with surrogate standards for all organic analyses.

Following MS analysis the percent recovery of each spiked analyte is calculated and compared to historical control limits. If recovery values for the spiked compounds fall within specified limits, the analytical process is considered to be in control. When calculated recovery is outside of historical limits corrective action is recommended.

Matrix spike duplicate (MSD) analyses are often used to measure method precision and accuracy. In this case the relative percent difference for recovery of spiked compounds is calculated and compared to established criteria.

Unless directed otherwise, ARI's policy is to prepare a matrix spike and a duplicate with each batch of samples for inorganic analysis and an MS/MSD set for each batch of samples for organic analyses. Analyte recovery and RPD values are reported with sample data.

11.3.6 Standardized Reference Material (SRM)

An SRM is material analyzed and certified by an outside organization to contain known quantities of selected target analytes independent of analytical method. SRMs are normally purchased from outside suppliers outside of ARI and are supplied with acceptance criteria. Analysis of SRM is used to assess the overall accuracy of ARI's analytical process. SRM are routinely analyzed with each batch of samples for wet chemistry (conventionals analysis) samples. External reference samples are analyzed after instrument calibration and prior to sample analysis. Compound recovery values not within the specified limit signal the need to evaluate either the calibration standards or instrumentation.

11.3.7 Other Quality Indicators

In addition to analyzing the quality control samples outlined previously, various indicators are added to environmental samples to measure the efficiency and accuracy of ARI's analytical process. Surrogate standards are added to extractable organic samples prior to extraction to monitor extraction efficiency. Surrogate standards will also be added to volatile organic samples prior to analysis to monitor purging efficiency. Internal standards are added to metals digestates for ICP-MS analyses and to organic samples or extracts prior to analysis to verify instrument operation.

The calculated recovery of surrogate analytes is compared to historical control limits to aid in assessing analytical efficiency for a given sample matrix.

11.4 Control Limits

To provide a means for evaluating whether or not a process is in control, acceptance limits have been established. These are based on internal, historical data for organic analyses and method specified limits for inorganic analyses. Samples associated with a specific program or contract (such as the USEPA Contract Laboratory Program) will be evaluated against program/contract-specified criteria. Routine samples will be evaluated against internally generated control limits. Project specific control limits will be used as required provided they have been reviewed for feasibility and approved by laboratory management.

Results of QA analyses are transferred from the LIMS to a control limit and chart generation program. The QAPM coordinates control chart and control limit generation. Control limits will be generated for LCS compound recoveries, surrogate recoveries, and matrix spike compound recoveries, on a method and matrix specific basis. Advisory control limits will be utilized for analyses performed on an infrequent basis until a sufficient number of usable data points are collected. Control limits are updated at least annually, but may be updated more frequently if method or instrument changes have been made. Laboratory control and acceptance limits are detailed in Appendix K.

Two levels of control limits are utilized in evaluating process control: warning limits and action limits. Limits are statistically determined from values obtained from LCSs or other control samples. Warning limits, within which 95% of all results are expected, equal ± two standard deviations from the average result. Action limits, within which 99.7% of all results are expected, are equal to ± three standard deviations from the average result. Mean values, warning limits, and action limits are necessary for thorough evaluation of process control.

11.5 Control Charts

Control charts, in conjunction with other control sample analyses, are useful in verifying that an analytical procedure is performing as expected. The control chart provides a pictorial representation of how closely control sample results approximate expected values, as well as showing analytical trends. Indicated on the control chart are the mean and upper and lower warning and action limits. The warning and action limits are used to determine whether or not an analytical process is in control. The mean is used to determine whether results obtained for a procedure are trending upward or downward, which may ultimately affect the accuracy of sample results.

The QA Officer will coordinate generation of control charts based on laboratory data at least semi-annually. These control charts will be distributed to and reviewed by section supervisors and managers. Any significant trends or variations in results will be identified, and the source of the trend corrected. Copies of control charts will remain on file in the QA section. At the bench/instrument level, individual results from quality control samples are evaluated against the limits.

SECTION 12: CORRECTIVE ACTIONS AND REESTABLISHMENT OF CONTROL

To produce quality data, it is important that all aspects of the analytical process are under control and that all specified quality control criteria are met. On occasion, however, procedures, reagents, standards, and instrumentation can fail to meet specified criteria. Should any of those situations occur, the quality of data produced may be compromised. When procedures no longer appear to be in control, sample processing will be halted and appropriate actions will be taken to identify and rectify any instrument malfunctions or process-related issues. Prior to resuming sample analysis, verification of control will be made through the analysis of various control samples. Actions taken and observations made during reestablishment of control will be fully documented on the bench sheet or as an Analyst Note. Only when control has been regained and all actions documented will sample processing resume. This ensures that no results generated during the suspect period will be reported.

12.1 Responsibilities

It is the responsibility of all laboratory personnel involved with sample processing to be able to determine whether or not a procedure is in control and to verify that all data are produced under conditions that are "in control". It is at the analytical level that unacceptable conditions are most easily detected and addressed. These personnel are also responsible for employing and documenting all necessary corrective actions taken to regain control of a procedure. Samples processed during suspect periods will be reprocessed, and suspect data will be appropriately annotated to indicate that it is of questionable quality. The analytical staff will verify that all data submitted for review has been generated under acceptable conditions. All anomalies will be documented on the Analyst Notes form and will include such information as: type and source of anomaly, reasons for the anomaly, and actions taken to correct the problem. All personnel involved with subsequent and final data review are responsible for verifying that data were generated under acceptable conditions. If suspect data are identified at the review level, responsible analysts should be contacted to determine whether additional actions (such as reanalysis) will be taken. In addition, reviewers will confirm that anomalies noted by the analyst were indeed addressed and that appropriate corrective actions were taken.

On occasion, it is not possible to generate data that meet all Quality Control Standards. This may be due to sample volume limitations or sample matrix effects. It is the responsibility of the analytical and data review staff to document these situations and to maintain communication with the Project Management staff. The Project Management staff, in turn, is responsible for notifying the client or specifying additional actions to be taken. Project Managers are further responsible for ensuring that clients fully understand which data are questionable and the reasons why acceptable results could not be generated.

It is the responsibility of the QAPM to perform regular reviews of corrective action procedures to ensure that unacceptable conditions or suspect data will be identified prior to releasing results. Section managers and supervisors are responsible for ensuring that appropriate corrective action procedures are in place and that all staff members are trained to identify and act upon “out of control” situations.

12.2 Corrective Actions

There are various stages of the analytical process where the procedure may fall out of control and require corrective action. In general, all procedures and equipment will be monitored to verify that control is maintained during sample processing. The following details those stages as well as the actions taken to reestablish and verify control.

Sample Preparation

During sample preparation, all glassware associated with a specific sample will be clearly labeled to eliminate the possibility of sample mix-up or mislabeling. Laboratory staff will ensure that sample-identifying labels are accurately completed and that correct sample identification is maintained at all times. If a sample appears to have been misidentified or mixed with another sample during preparation, the suspect samples will be discarded and new aliquots taken. If there is insufficient sample for a second preparation, the situation will be documented on the bench sheet and the Project Manager will be immediately notified.

Addition of surrogate standards or matrix spiking solutions will be carefully monitored to ensure that all samples are accurately fortified. Volumes and standard solution numbers of all standards added to samples will be recorded on the bench sheet. If there is suspicion that a sample has been incorrectly spiked a new sample aliquot should be prepared. If there is insufficient volume for re-preparation, the bench sheet will be annotated to indicate which samples may be inaccurately fortified.

If sample matrix hinders processing per standard procedures, the section supervisor or manager will be consulted for guidance on appropriate actions. Preparation of smaller sample aliquots or employment of different procedures may be necessary. Any deviations from normal protocols will be documented on the bench sheet.

If at any time during sample preparation sample integrity is compromised or a procedural error is noted, the sample will be discarded and re-prepared. If insufficient sample volume is available for re-preparation, the situation will be documented on the bench sheet and the Project Manager will be immediately notified.

Calibration and Tuning

Prior to sample analysis, all instrumentation will be calibrated and tuned to ensure that equipment meets all criteria necessary for production of quality data. Equipment must meet the calibration criteria specified in the section entitled "Calibrations", per manufacturer specifications or per project/contract requirements. If these criteria are not met, corrective actions must be employed. Any corrective actions taken will be fully documented in the appropriate logbook, indicating the problem, the actions taken, and verification. Samples will not be analyzed until initial verification of system performance has been made. In the event that continuing calibration results do not meet criteria, sample analysis will not resume until corrective actions have been employed or the system has been re-calibrated.

GC/MS Analyses - Analysis of the instrument performance check solution (BFB or DFTPP) will meet the specified ion abundance criteria. Initial calibration standards at a minimum of five concentrations will meet specified response factor and percent relative standard deviation criteria. It criteria are not met for initial calibration, the system will be inspected for malfunction. The initial tuning and calibration will be repeated, with all necessary corrective actions taken, until calibration criteria are met.

A check of the calibration curve will be performed at a minimum of once every 12 hours. All response factor criteria will be met. Additionally, the percent difference between the initial and continuing calibrations will meet specified criteria. If criteria are not met, the system will be inspected for malfunction. The initial tuning and calibration verification will be repeated, with all necessary corrective actions taken, until calibration criteria are met.

Internal standard responses and retention times for standards will meet specified criteria. Any sample not meeting internal standard criteria will be reanalyzed. If reanalysis yields the same response and the instrument is determined to be functioning correctly, the failure to meet criteria will be attributed to sample matrix interference. No further re-analyses will be required.

GC Analyses - Organochlorine pesticide calibrations will be evaluated using either USEPA CLP or SW-846 guidelines. The Resolution Check standard will meet resolution criteria and Endrin and DDT breakdown in the Performance Evaluation standard will meet breakdown criteria. Initial calibrations will meet percent relative standard deviation criteria. If, during the initial calibration sequence, criteria are not met, the system will be inspected for malfunction and the initial calibration be reanalyzed. Samples will not be analyzed until all initial calibration criteria are met.

Continuing calibrations of either the mid-level calibration standard or Performance Evaluation standard will be analyzed every 12 hours. If continuing calibration criteria are not met, the system will be inspected for malfunction and corrective actions will be taken to bring the system back into compliance. If, after corrective actions, the system is still not in compliance, re-calibration will be performed. After the system has been successfully corrected or re-calibrated, all samples previously analyzed between the acceptable and unacceptable continuing calibration will be reanalyzed.

If, during the analytical sequence, retention time shifting occurs, the system will be inspected for malfunction and corrective actions will be taken to bring the system back into compliance. If, after corrective actions, the system is still not in compliance, re-calibration will be performed. After the system has been successfully corrected or re-calibrated, all samples with retention times outside the specified windows will be reanalyzed.

For all other analyses, initial calibration standards analyzed at a minimum of five concentrations will meet percent relative standard deviation criteria. If criteria are not met for initial calibration, the system will be inspected for malfunction. The calibration will be repeated, with all necessary corrective actions taken, until calibration criteria are met.

A check of the calibration curve will be performed after every 10 samples. All percent differences between the initial and continuing calibrations will meet specified criteria. If criteria are not met, the system will be inspected for malfunction and re-calibration will be performed. Samples analyzed between an acceptable and unacceptable calibration check will be reanalyzed.

Metals and Inorganic Analyses - Initial calibrations will be verified by analyzing a calibration check standard immediately after calibration. The percent differences between the initial calibration and calibration check standard will meet specified percent difference criteria. If criteria are not met, the system will be inspected for malfunction. The initial calibration and calibration check will be reanalyzed until acceptance criteria are met.

The calibration check standard analyzed after every 10 samples will meet percent difference criteria. If the calibration check standard is not acceptable, the system will be inspected for malfunction and re-calibration will be performed as necessary. Samples analyzed between acceptable and unacceptable calibration check standards will be reanalyzed.

Instrument Blanks

Prior to sample analysis, instrument and/or calibration blanks may be evaluated for the presence of target analytes. If analytes are detected, the concentrations must be below the reporting limits for those analytes. If analytes are detected at levels above the reporting limits, the source of contamination will be identified. Sample analysis will not commence until analyte levels in instrument and calibration blanks are below the reporting limits. Instrument and calibration blanks are analyzed for VOA analysis only if sample carryover is suspected.

Instrument and calibration blanks will also be analyzed throughout the analytical sequence. These will not contain target analytes at levels above the method detection limits for organic parameters or the reporting limit for inorganic parameters. If one or more analytes exceed the RL, an additional blank will be analyzed. If analyte levels are still above the method detection limits, the system will be inspected for malfunctions and the source of contamination will be identified. Sample analysis will not resume until instrument and calibration blank analyte levels are below the RL. Organic samples analyzed between acceptable and unacceptable blanks will be evaluated to determine the need for reanalysis per the following guidelines:

If no target analytes are detected in the samples, reanalysis will not be required.

If sample target analyte levels are above the method detection limits, samples will be reanalyzed at analyst discretion. Reanalysis will be dependent upon the analyte levels and whether or not there is likelihood that analytes detected are a direct result of system contamination.

If the analytes present at unacceptable levels in the instrument blank are not of interest or concern in the associated samples, reanalysis will not be required. This is often a consideration for ICP analyses where analytes of concern may be only a subset of the possible analytes.

Methods for the analysis of inorganic analytes require that all samples associated with an out of control blank be re-analyzed.

Method Blanks

Prior to sample analysis, method blanks will be evaluated for the presence of target analytes. Ideally, no target analytes should be present in the method blank. If analytes are detected at or above the Reporting Limit, the method blank will be reanalyzed to verify that the contamination is not a result of instrument carryover or malfunction. If the presence of target analytes is confirmed, the concentrations must be below the RL for those analytes.

Several volatile and semi-volatile compounds and certain elements are considered to be common laboratory contaminants. Concentrations of these common laboratory contaminants may exceed the method detection limits, but may not be present at concentrations greater than five times the method reporting limits. Target analytes considered to be common laboratory contaminants are:

Volatile Organic Compounds

Methylene Chloride
Acetone
2-Butanone

Semi-volatile Compounds

Dimethylphthalate
Diethylphthalate
Di-n-butylphthalate
Butylbenzylphthalate
bis-(2-Ethylhexyl) phthalate
Di-n-octylphthalate

If target analyte concentrations in the method blank exceed the acceptable levels and instrument malfunction or contamination has been ruled out, the method blank and all associated samples will be re-prepared and reanalyzed. If there is insufficient sample volume remaining for reprocessing, the Project Manager will be notified. If it is necessary to report results associated with an unacceptable method blank, the results will be qualified to indicate possible laboratory contamination.

In the event that an analyte detected in the samples ≥ 20 times the method blank levels re-preparation and reanalysis is not required. It is assumed that any contamination in the method blank is insignificant and will not affect final quantified results.

Laboratory Control Samples

Prior to sample analysis, the laboratory control sample (LCS) will be evaluated to verify that recovery values for all spiked compounds are within the specified acceptance limits. If LCS recoveries are out of control, corrective action is required. Corrective actions may include anything from a written explanation in the case narrative up to re-preparation and reanalysis of the entire sample batch.

Internal Standards

For volatile and semi-volatile organic analyses, internal standard results will be evaluated after each analytical run to verify that the values are within acceptance limits. Internal standard values will be within -50% to +100% of the internal standard values in the continuing calibration. If any internal standard does not meet the criteria, the system will be evaluated to confirm that all instrumentation is operating properly. The sample will then be reanalyzed. If the reanalysis results do not meet acceptance criteria, it will be assumed that the sample matrix is affecting internal standard values. Further reanalysis will not be required.

Surrogate

Surrogate recovery values will be evaluated after each analytical run to verify that the values are within acceptance limits. If recovery values are outside acceptance limits, the system will be evaluated to confirm that all instrumentation is operating properly. Documentation and bench sheets will be reviewed to verify that the concentrations of surrogate spike solutions added are accurate. For extractable organic analysis, bench sheets will be reviewed to determine if any additional dilutions or concentrations were performed. Bench sheets will also be reviewed for any explanatory notes about the sample.

If no system documentation, solution preparation or spiking errors are identified, the following considerations will be made:

When a volatile organic surrogate recovery value is outside of acceptable limits, the sample will be reanalyzed. If the reanalysis results are within acceptance limits, it will be assumed that the initial analysis was in error. If the reanalysis results are not within acceptance limits, it will be assumed that sample matrix is affecting surrogate recovery. Further reanalysis will not be required.

For semi-volatile organic analysis, one acid and one base/neutral surrogate recovery may be outside acceptance limits with no corrective action required provided the recoveries are at least 10%. If more than one acid or base surrogate standard is outside acceptance limits, or if any surrogate recovery value is less than 10%, the sample will be re-extracted and reanalyzed. If the reanalysis results are not within acceptance limits, it will be assumed that sample matrix is affecting surrogate recovery assuming all other QC analyses are acceptable. Further reanalysis will not be required. *Matrix spikes will not be re-extracted for unacceptable surrogate recovery values.*

For other extractable organic analysis, if a surrogate recovery value is outside of acceptance limits, the data will be reviewed to determine if the unacceptable surrogate is a result of matrix effect. If matrix interference is determined, the sample will be re-extracted or if re-extraction is not deemed useful, fully documented in the analytical narrative associated with the analyses. If a surrogate recovery is too low, based on the opinion of the final QA Data Reviewer, the sample will be re-extracted and reanalyzed.

Matrix Spikes

Matrix spikes will be evaluated to verify that recovery values for all spiked compounds are within the specified acceptance limits. If unacceptable results are obtained, the system will be evaluated to confirm that all instrumentation is operating properly. Documentation and bench sheets will be reviewed to verify that the concentrations of spike solutions added are accurate. Sample preparation bench sheets will be reviewed to determine if any additional dilutions or concentrations were performed. Bench sheets will also be reviewed for any explanatory notes about the sample.

If no system, documentation, solution preparation, or spiking errors are identified, the following considerations will be made:

Organic Analyses:

If a matrix spike recovery value is outside the acceptance limits, but the LCS meets recovery acceptance criteria, re-extraction will not be required. It will be assumed that the unacceptable recovery value is a result of matrix effect.

If both LCS and matrix spike recovery values are outside the acceptance limits, the sample batch will be re-extracted and reanalyzed. This indicates the possibility of a systematic error that may affect the accuracy of final results.

Inorganic analyses:

Matrix spikes with unacceptable recovery values will be re-prepared and reanalyzed. If the reanalysis results are not within acceptance limits, it will be assumed that the sample matrix is affecting the recovery values. Further reanalysis will not be required.

A post-digestion spike analysis will be performed for all metals analyses processed following EPA-CLP guidelines.

Sample and Matrix Spike Replicates

Sample and matrix spike replicates will be evaluated to verify that percent differences between the replicates are within acceptable limits. Percent differences for metals and inorganic sample replicates will be within ±20%. When percent difference criteria are not met, the system will be evaluated to confirm that all instrumentation is operating properly. Documentation and bench sheets will be reviewed to verify that the concentrations of spike solutions added are accurate. Sample preparation bench sheets will be reviewed to determine if any additional dilutions or concentrations were performed. Bench sheets will also be reviewed for any explanatory notes about the sample.

If no system, documentation, solution preparation, or spiking errors are identified, the following considerations will be made:

If percent difference values between sample replicates for metals and inorganic analyses do not meet acceptance criteria the Project Manager in consultation with ARI's client will determine whether to re-analyze the samples or flag the analytical results. If the samples are reanalyzed and results are not within acceptance limits, it will be assumed that the sample is not homogeneous, causing the poor analytical precision. Further re-analyses will not be required.

Replicate sample analyses are not routinely performed for organic parameters.

If percent difference values between matrix spike replicates do not meet acceptance criteria, but spike recovery values are acceptable, no re-extraction or analysis will be required. It will be assumed that the sample is not homogeneous, causing the poor analytical precision.

If percent difference values between matrix spike replicates do not meet acceptance criteria and recovery values in one or both replicates are not acceptable, the sample and associated matrix spike replicates will be re-prepared and reanalyzed. If the reanalysis results are not within acceptance limits, it will be assumed that the sample is not homogeneous, causing the poor analytical precision. Further re-analyses will not be required.

Samples

In addition to monitoring sample quality control indicators, ARI evaluates samples to determine the need for reanalysis. Conditions considered while evaluating samples are:

If a target analyte detected in a sample exceeds the upper limit of the instrument calibration range, the sample is diluted and reanalyzed. Dilution and reanalysis continues until the analyte concentration falls within the linear range of calibration. If the sample requires dilution to such a level that surrogates are no longer detectable and analytical accuracy is questionable, the sample will be re-prepared using a smaller sample aliquot.

Samples will be evaluated for matrix interference that may affect analyte detection and quantification. Appropriate cleanup procedures will be employed to remove interference. Samples will be diluted and reanalyzed as required to minimize background interference. If it is not possible to remove all interference, reported results will be qualified as necessary.

If low-level analytes detected in a sample are suspected to be a result of instrument carryover, the sample will be reanalyzed. If analyte levels remain approximately the same the initial results will be considered valid. If analytes are not detected during reanalysis, it will be assumed that the initial detection was due to carryover, and the initial results will not be reported.

If an instrument malfunction or procedural error occurs during analysis, all affected samples will be reanalyzed. If the malfunction appears to be an isolated incident, it will not be necessary to inspect the analytical system. If the malfunction appears to be an ongoing problem, the system will be inspected and necessary maintenance/corrective actions will be taken prior to resuming analysis.

Sample Storage Temperatures

Every sample storage unit's temperature will be evaluated at the beginning of each day. Temperatures will be between 2 and 6 °C for refrigerators and < -10 °C for freezers. If a temperature is outside the specified range, the unit's temperature will be adjusted to bring the temperature back within limits. The Temperature Log will be annotated to document the adjustment.

If adjustment does not bring the temperature within range, or if adjustment is not possible, the Laboratory Supervisor will be notified and will take corrective action. The Temperature Log will be annotated to document the action. If the temperature fluctuation is chronic or extreme, the samples will be removed from the unit and placed in another storage unit until the malfunctioning unit is repaired or replaced.

Balance Calibrations

Balances are serviced once a year by a certified technician. The service includes preventative maintenance and calibration.

Balance accuracy will be verified prior to balance use. The recorded weight will be within the acceptance criteria specified on the Calibration Log. If the recorded weight is not within the acceptance limits, the QAPM will be notified. The Calibration Log will be annotated to document the action. The balance will not be used until it can be verified that acceptance criteria can be met.

Water Supply System

The water supply for the volatile organic and inorganic laboratories will be monitored daily for the presence of contaminants through the analysis of method and/or instrument blanks. Organic contaminants, especially chloroform, are early indicators of the need for preventative maintenance. If organic or other contaminants are detected, the system filters will be changed. After filters have been changed, an additional aliquot of water will be analyzed to confirm that contaminants are no longer present.

The water supply for the metals laboratory will be monitored daily. When the resistivity falls below 18 megaohm, system maintenance will be performed.

Section 13: LABORATORY EVALUATION AND AUDITS

Routine evaluations of the laboratory ensure that all necessary quality control activities have been implemented and are being effectively utilized. It is the responsibility of the QAPM to ensure that quality control activities are periodically evaluated for compliance. Findings from these evaluations allow the laboratory to address and modify any procedures that are not in accordance with the laboratory Quality Assurance Program or accreditation program requirements.

A number of tools are available for monitoring laboratory performance. ARI evaluates the quality of laboratory performance through the use of

Internal QA Audits
Technical System Audits
Data Quality Reviews
Audits by Outside Agencies (External Audits)
Performance Evaluation Analyses
Annual Management Review

Each audit provides an objective evaluation of laboratory performance. All internal audits and reviews are conducted according to specified guidelines. In addition, a collective review of audit findings provides an overall evaluation of the laboratory. Deficiencies noted during the course of an audit or performance evaluation will be addressed, a root cause analysis performed, and appropriate corrective actions will be taken. Follow-up audits will be conducted to verify that corrective actions have been satisfactorily implemented.

<u>Internal QA Audits</u>
The Quality Assurance Officer regularly evaluates quality control activities within the laboratory to verify accuracy and compliance. The QAPM or designee routinely audits the following activities:

Balance verification records
Sample storage cooler temperature records
Oven, incubator and water bath temperature records
Chain of Custody records

Standard preparation records

Documentation and Response to Client Complaints

Chain of Custody Procedures

Documentation of Computer and Software Revisions

Checklists are utilized to ensure consistent and complete audits. The checklists are included in SOP 1005S. Internal QA audit results will be summarized and reported to both staff and management. Corrective actions will be initiated as necessary. A schedule of internal QA audits is provided in Appendix L.

When an audit finding indicates possible errors or deficiencies in analytical data, ARI will correct the error and notify all affected clients within 2 working days.

<u>Technical System Audits</u>

An audit of technical systems within the laboratory will be conducted at least annually. The audit will focus on the quality control and data generation/collection systems. The QAPM will conduct the audit with assistance from section managers and data reviewers. This evaluation will address areas such as:

Calibration records

Maintenance records

Control charts

Computer vs. hard copy data

Adherence to SOPs and methods

Support system records (DI water, balances, pipettes, etc.)

In addition, audit results from the past year will be reviewed to verify that all necessary corrective actions have been addressed and implemented.

<u>Data Quality Reviews</u>

Reviews of final data packages by the QAPM or his/her designee. The Data quality review verifies that the final data deliverables meet project and quality systems specifications

Audits by Outside Agencies (External Audits)

As a requirement for many accreditation programs, on-site review of laboratory facilities and operations are conducted by clients or other outside agencies. The laboratory may be periodically audited by the following agencies:

State of Washington Department of Ecology
A United States Department of Defense Agency (US Army, US Navy or US Air Force)
State of Oregon Environmental Laboratory Accreditation Program (ORELAP) as an Accrediting Body for The NELAP Institute.

External audits are beneficial in that they provide an independent evaluation of the laboratory without internal influence or bias. The laboratory will be available for evaluation at the convenience of the auditing agency. Laboratory personnel will be available during the audit to address questions or provide information regarding laboratory procedures. All comments, deficiencies, and areas of potential improvement noted by the auditor will be reviewed, and appropriate corrective actions will be taken to resolve the noted issues. A listing of laboratory accreditations is included as Appendix M.

Performance Evaluations

Performance Evaluation (PE) sample analysis is a means of evaluating individual performance as well as the overall analytical system. In addition to the external audit, PE sample (PES) analysis is a requirement of many certification and accreditation programs. The laboratory routinely participates in the following performance evaluation programs:

Analytical Standards, Inc.(ASI) Performance Evaluation Studies
USEPA Water Pollution (WP) Performance Evaluation Studies (Commercial Supplier)
USEPA Water Supply (WS) Performance Evaluation Studies (Commercial Supplier)
USEPA Contract Laboratory Program Quarterly Performance Evaluations (as required)
AASHTO (for geotechnical samples)

A PES is a sample containing specific analytes in concentrations unknown to analysts. Comparison of the laboratory result to the "true" value determines the accuracy of the reported result and indicates the laboratory's ability to perform a given analysis. These results are also used to verify individual analyst proficiency. The QAPM will periodically submit internal “blind” performance evaluation samples to the laboratory sections for analysis. Values obtained by the laboratory will be compared to expected or true values. Parameters with reported values outside of the specified acceptable ranges will be evaluated by the analytical staff to determine the source of error. All necessary corrective actions will then be documented and implemented.

Quality Assurance Reports to Management and Staff

In order to ensure that laboratory managers are kept apprised of quality related activities and laboratory performance, a “Quality Assurance Report to Management” the QAPM will be produced annually and distributed to ARI management. The report will, at a minimum include:

1. Information concerning current and ongoing internal and external audits
2. Status and results of current or ongoing internal or external proficiency analyses
3. Identification of Quality Control problems in the laboratory
4. Information on all ongoing Corrective Actions
5. Current status of external certifications
6. Current status of the Staff Training Program
7. Outline of new and/or future Quality Assurance Program initiatives

The QAPM is responsible for follow-up and resolution of any deficiencies discussed in the report. Unresolved issues will remain on subsequent reports until addressed. Information such as performance evaluation results and audit reports will be distributed to the laboratory staff.

The application of these combined activities provides comprehensive monitoring and assessment of laboratory performance, and ensures that all data produced by ARI will be of the highest possible quality.

Annual Management Review

In the last quarter of each year, executive management will perform a comprehensive review of ARI quality system and analytical procedures to assess their continued suitability and effectiveness. Management will consider the following during the review process:

Suitability of policies and procedures

Reports fro management and supervisory personnel

Results of internal audits

Corrective and preventative actions

Results of recent external quality systems audits

PT results

Changes in volume and type of analyzes performed

Client Feedback

Complaints

Other relevant factors such as quality control activities, available resources and analyst training

Section 14: APPENDICES

A. **Laboratory Organization and Key Personnel Resumes**
B. **Training and Demonstration of Proficiency**
C. **Laboratory Facilities**
D. **Laboratory Instrumentation and Computers**
E. **Standard Operating Procedures**
F. **Sample Collection Containers, Preservation and Holding Times**
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Appendix A

Laboratory Organization Chart
and
Key Personnel Resumes

KEY PERSONNEL RESUMES

Mark Weidner

Laboratory Director

Profile

Mr. Weidner co-founded Analytical Resources, Inc., along with Brian Bebee, Sue Dunnihoo and David Mitchell. Prior to his co-founding of ARI in 1985, Mr. Weidner was the Head Mass Spectroscopist at Michigan State University and an instructor at the Finnigan Institute. As Laboratory Director, Mr. Weidner is responsible for overall laboratory performance, as well as facility expansion and major purchasing. Mr. Weidner is intimately familiar with all operational and analytical aspects of ARI and initiated many of the procedures currently in use.

Education:

M.S., Medicinal Chemistry, Purdue University, W. Lafayette, IN (1978).

B.S., Biochemistry, Michigan State University, E. Lansing, MI (1975).

Experience:

Laboratory Director/Co-founder, Analytical Resources, Inc., Seattle, WA (1985 to present).

Senior Chemist, City of Seattle, Seattle, WA (1981 to 1985).

Instructor, Finnigan Institute, Cincinnati, OH (1979 to 1981).

Mass Spectroscopist, Michigan State University (1978 to 1979).

Brian Bebee

Laboratory Manager

Administrative Services Manager

Profile:

Mr. Bebee co-founded Analytical Resources, Inc., along with Mark Weidner, Sue Dunnihoo, and David Mitchell. Prior to his co-founding of ARI, Mr. Bebee had gained extensive GC/MS experience as a GC/MS Chemist at the Municipality of Metropolitan Seattle, (METRO). When he co-founded ARI in 1985, Mr. Bebee became the Organics Division Manager until 1993, when he assumed the position of Laboratory Manager. As Laboratory Manager, Mr. Bebee is responsible for the day to day flow of all laboratory operations, including personnel, instrument, and procedural concerns. He is also responsible for the direct supervision of the Volatile and Semivolatile Laboratories.

Education:

A.A., Oceanography, Marine Biology, Biology, Shoreline Community College (1973).

Experience:

Laboratory Manager, Analytical Resources, Inc., Seattle, WA (1987 to present).

Organics Division Manager/Co-founder, Analytical Resources, Inc., Seattle, WA (1985 to 1987).

GC/MS/DS Operator, Municipality of Metropolitan Seattle, Seattle, WA (1980 to 1985).

Senior Water Quality Technician, Municipality of Metropolitan Seattle (METRO), Seattle, WA (1976 to 1980).

Water Quality Technician, Municipality of Metropolitan Seattle (METRO), Seattle, WA (1973 to 1976)

David Mitchell

Quality Assurance Program Manager

Profile:

Mr. Mitchell co-founded Analytical Resources, Inc., along with Mark Weidner, Sue Dunnihoo, and Brian Bebee. Prior to his co-founding of ARI, Mr. Mitchell had gained extensive experience in the environmental chemistry field as Senior Chemist and Trace Organics Laboratory Supervisor at the Municipality of Metropolitan Seattle (METRO). His responsibilities include the management of ARI's Quality Assurance/Quality Control Program.

Education:

Graduate Work in Chemistry (Organic/Biological), University of Wyoming, Laramie, WY (1970 to 1974).

B.S., Chemistry, Upper Iowa College, Fayette, IA (1970).

Experience:

Quality Assurance Manager, Analytical Resources Inc., Seattle, WA (1998 to Present)

Client Services Manager, Analytical Resources Inc., Seattle WA (1987 to 1998)

Vice President/Co-founder of Analytical Resources, Inc., Seattle, WA (1985 to 1987).

Senior Chemist, METRO Trace Organics Laboratory, Seattle, WA (1979 to 1985).

Research Associate, Northwestern University Medical School (1974 to 1979).

Susan Dunnihoo

Director, Client Services

Profile:

Ms. Dunnihoo co-founded Analytical Resources, Inc., along with Mark Weidner, Brian Bebee, and David Mitchell. Prior to her co-founding of ARI, Ms. Dunnihoo had gained extensive experience in the environmental chemistry field through her work at Laucks Testing Laboratories, the City of Tacoma, and the Municipality of Metropolitan Seattle (METRO). As Director of Client Services, Ms. Dunnihoo is responsible for assisting project managers in responding to the needs of ARI clients, and for communicating to the laboratory the analytical capabilities that should be added to satisfy future client needs. Ms. Dunnihoo also acts as project manager for a number of projects.

Education

Graduate work in Chemical Oceanography, University of Washington (1976-1980)
ACS Certified BA, Chemistry, Augsburg College, Minneapolis, MN (1976)

Experience

Director, Client Services, Analytical Resources, Inc., Seattle, WA (2007-present)
Client Services Manager, Analytical Resources, Inc., Seattle, WA (1998-2007)
Computer Services Manager, Analytical Resources, Inc., Seattle, WA (1985 to 2000)
Corporate Secretary, Analytical Resources, Inc., Seattle, WA (1985 to present)
Chemist, Laucks Testing Laboratories, Seattle, WA (1983 to 1985)
Chemist, City of Tacoma, Plant II, Tacoma, WA (1982 to 1983)
GC/MS/DS Operator, METRO TPSS Lab, Seattle, WA (1980 to 1982)

Jay Kuhn

Inorganic Division Manager

Profile:

Mr. Kuhn oversees ARI's Inorganic Division, which includes the Metals Sample Preparation, Metals Analysis, and Conventional Wet Chemistry sections. He has extensive experience in the environmental chemistry field, with an emphasis in inorganic analyses. Mr. Kuhn is experienced with in-house and EPA standard methods and protocols, as well as the operation, maintenance, and repair of ICP-MS, ICAP, CVAA, and Graphite Furnace instruments.

Education

Graduate work in Environmental Chemistry, University of Washington, Seattle, WA.

B.S. Chemistry, University of California at Santa Barbara (1980)

Experience

Inorganic Division Manager, Analytical Resources, Inc., Seattle, WA (1992 to present)

Metals Division Manager, Analytical Resources, Inc., Seattle, WA (1990 to 1992)

Research Technologist III and Laboratory Manager, UW College of Forest Resources Chemical Analysis Cost Center (1985-1990)

Research Technologist, UW College of Forest Resources Chemical Analysis Cost Center (1981 to 1985)

Appendix B

Training

Qualification Requirements
In addition to on-the-job training, ARI recommends a specific level of education and experience for the following positions:

GC/MS Laboratory Supervisor
A Bachelor's degree in chemistry or scientific/engineering discipline, three years experience operating GC/MS systems and one year supervisory experience.

GC Laboratory Supervisor
A Bachelor's degree in chemistry or scientific/engineering discipline, three years experience operating GC systems and one year supervisory experience.

Sample Preparation Laboratory Supervisor
A Bachelor's degree in chemistry or scientific/engineering discipline, three years experience in organic sample preparation and one year supervisory experience.

Data Systems/LIMS Manager
A Bachelor's degree with four or more computer-related courses and three years experience in systems management or programming. A minimum of one year experience with software utilized for laboratory report generation is also recommended.

Programmer Analyst
A Bachelor's degree with four or more computer-related courses and two years experience in systems or application programming. A minimum of one year experience with software utilized for laboratory report generation is also recommended.

Quality Assurance Officer
A Bachelor's degree in chemistry or a scientific/engineering discipline and three years of laboratory experience, including one year of applied experience with quality assurance.

Project Manager
A Bachelor's degree in chemistry or a scientific/engineering discipline and three years of laboratory experience, including one year of applied experience with quality assurance.

GC/MS Chemist
A Bachelor's degree in chemistry or a scientific/engineering discipline and at least one year experience operating a GC/MS system. Three years of GC/MS operations and spectral interpretation experience may be substituted in lieu of educational requirements.

Mass Spectral Interpretation Specialist

A Bachelor's degree in chemistry or a scientific/engineering discipline and participation in training course(s) in mass spectral interpretation. Also, at least two years of experience in mass spectral interpretation is recommended.

Purge and Trap Expert

A Bachelor's degree in chemistry or a scientific/engineering discipline and one year experience operating a purge and trap type liquid concentrator interfaced to a GC/MS system.

GC Chemist

A Bachelor's degree in chemistry or a scientific/engineering discipline and at least one year experience operating a GC system. Three years of GC operations and maintenance experience may be substituted in lieu of educational requirements.

Pesticide Analysis Expert

A Bachelor's degree in chemistry or a scientific/engineering discipline and at least one year experience operating a GC system. Three years of GC operations and spectral interpretation experience may be substituted in lieu of educational requirements.

ICP Spectroscopist

A Bachelor's degree in chemistry or a scientific/engineering discipline and Four years of applied experience with ICP analysis of environmental samples. Four years of ICP experience may be substituted in lieu of educational requirements.

ICP Operator

A Bachelor's degree in chemistry or a scientific/engineering discipline and one year of experience operating and maintaining ICP instrumentation. Three years of ICP experience may be substituted in lieu of educational requirements.

Atomic Absorption (AA) Operator

A Bachelor's degree in chemistry or a scientific/engineering discipline and one year of experience operating and maintaining graphite furnace and cold vapor AA instrumentation. Three years of AA experience may be substituted in lieu of educational requirements.

Conventionals (Classical Chemistry) Analyst

A Bachelor's degree in chemistry of a scientific/engineering discipline and one year of experience with classical chemistry procedures. Three years of classical chemistry experience may be substituted in lieu of educational requirements.

Sample Preparation Expert

A high school diploma and one college level course in chemistry. One year of experience in sample preparation is also recommended.

Appendix C

Laboratory Facilities

ANALYTICAL RESOURCES INC. occupies a total of 23,500 square feet of floor space located at 4611 S. 134th Place in Tukwila, Washington. The laboratory facility, constructed between September 2001 and June 2002, includes:

- State-of-the-art heating, ventilation and air conditioning (HVAC) systems to assure a clean comfortable working environment while maintaining air flow balance designed to minimize the possibility of sample cross contamination between laboratory areas.
- A central service area provides space for three walk-in coolers (356 sq. ft. total), two walk-in freezers (760 cubic ft.), metals archive storage, and sample cooler storage. A 400 sq. ft. walk-in freezer covered by a mezzanine for storage was added in 2005.
- A data network linking all workstations to a centralized server room. All connections are made to managed switches and hubs and are protected by the latest firewall technology and uninterruptible power supplies.
- Distribution systems to deliver pressurized Air, Zero Grade Air, Argon, Helium, Hydrogen, Nitrogen and Argon/Hydrogen to the laboratory areas from a central location.
- A system to deliver ASTM Type 1 water directly to sinks in each laboratory area. Water is purified by filtration, ion exchange and reverse osmosis and continuously re-circulated through a filtration + ion exchange + UV radiation polishing loop that delivers water directly to the laboratories.
- An isolated and ventilated hazardous waste storage area.
- An electronic repair shop and storage room.
- Alarm monitored fire sprinkler and intrusion detection systems

The facilities are divided into five functionally-distinct sections as detailed below:

1) The Organics Division features three main laboratory areas as described below:
   - The <u>Organics Extraction Laboratory</u> (2400 sq. ft.) is utilized to isolate and concentrate organic compounds from various environmental sample matrices. The laboratory contains approximately 200 linear feet of bench space and nine fume hoods. It is equipped with two gel permeation chromatographs, an accelerated solvent extractor (ASE) and a gas chromatograph for extract screening purposes. The laboratory includes a separate area for extraction of aqueous samples, a glassware cleaning area and individual workstations for the laboratory supervisor and analyst.
   - The <u>Semivolatile Organics Analysis Laboratory</u> (3000 sq. ft) has 124 linear feet of instrument bench space plus personal workstations. The Laboratory is equipped with seven Gas Chromatographs (GCs) with six GC-MS instruments, one High Resolution GC/MS (HRGC-MS) and a fume hood for preparation of standard solutions and dilution of samples. Each gas chromatograph is individually vented to the outside for removal of heat and potentially contaminated GC exhaust gases.
   - The <u>Volatile Organics Analysis (VOA) Laboratory</u> (2500 sq. ft) houses seven GC-MS and two GC-PID instruments dedicated to volatile organics analysis. Each instrument is vented to the outside. The laboratory area includes two fume hoods, a sample/standards preparation area, a TCLP preparation/tumbler room and sample holding refrigerators. The HVAC system maintains a positive air pressure in the laboratory using filtered air from outside of the building. This eliminates the possibility of cross contamination of samples with solvents from other areas of the laboratory.

2) The Inorganic Division includes a Trace Metals Laboratory and the Conventional Analyses Laboratory:

- Trace Metals Laboratory (3000 square feet)
    - The Metals Preparation Laboratory (1200 sq. ft) contains five fume hoods including two 8-foot polypropylene. An additional eight foot polypropylene laminar flow fume hood is housed in a separate class 1000 clean room. The lab is equipped with tumblers, hot-plates, digestion blocks, facilities for glassware cleaning, and a spectrophotometer for cold vapor analysis of mercury, a TCLP tumbler room, and storage areas.
    - The Metals Instrument Laboratory (1300 sq. ft) features two atomic absorption spectrometers for graphite furnace analyses, two inductively coupled argon plasma spectrometers (ICP) for simultaneous analysis of metals species, and an ICP-mass spectrometer for analysis of metals species at low detection levels.
    - A 500 sq. ft. Office provides desk area for Trace Metals laboratory personnel.
- The Conventional Analyses (Wet Chemistry) Laboratory (2500 sq. ft.) contains approximately 200 linear feet of bench space, eight fume hoods and includes a separate microbiology room. Instruments in this lab include two Rapid-Flow Analyzers, two TOC analyzers, an ion chromatograph, two uv/visible spectrophotometers, and various other equipment necessary for the evaluation of inorganic parameters.

3) The Geotechnical Laboratory includes 2500 square feet of space with special areas and equipment for soil testing, treatability studies, and soil/sediment leaching studies. The Laboratory includes approximately 50 feet of linear bench space and 5 fume hoods.

4) The Sample Receiving Facility consists of an area to accept and log-in samples to ARI's Laboratory Information Management System (LIMS) and an area to prepare and ship sampling supplies.

- The Sample Receiving Facility (1000 sq. ft.) is equipped with two fume hoods, and 70 feet of bench space. Four computer terminals are available to log samples into ARI's LIMS.
- The Sampling Containers Facility (500 sq. ft.) is used to prepare sampling containers for shipment to ARI's client designated locations.

4) Administrative Areas (8600 sq. ft.) include:

- The Quality Assurance Section
- Executive Offices
- Project Management Section
- The Human Resources Section
- The Computer Services Section
- One Conference Room
- A Lunch Room
- Several Storage Areas

Appendix D

Laboratory Instrumentation and Computers

LABORATORY INSTRUMENTATION and COMPUTERS

Organic Extractions Laboratory Equipment

(MARS 1) CEM MARS™ (2008) – Microwave extraction apparatus.

(MARS 2) CEM MARS™ (2010) – Microwave extraction apparatus.

(MARS 3) CEM MARS™ (2011) – Microwave extraction apparatus.

(GPC 1) Gel Permeation Chromatograph (1985) – Fluid Metering Inc. pump and ISCO UA-5 UV detector equipped with a 16 position autosampler used for clean-up of samples prior to final analysis.

(GPC 2) Gel Permeation Chromatograph (2003) – Fluid Metering Inc. pump and ISCO UA-5 UV detector equipped with a 16 position autosampler used for clean-up of samples prior to final analysis.

Zymark Turbo-Vap LV (1999) - 24 place

Zymark Turbo-Vap LV (2002) - 24 place

Zymark Turbo-Vap LV (2007) - 24 place

Zymark Rapid Trace Solid Phase Extraction Workstations (2007) - 5 each

Horizon Technology – DryVap Concentrator System Model 5000 – 2 each

Dioxin Extractions Laboratory Equipment

(MARS 1) CEM MARS™ Express (2010) – Microwave extraction apparatus.

Zymark Turbo-Vap LV (2010) - 24 place

Rotovap R-205 with V-805 Vacuum Controller (2010) – 2 each

Glas-Col Combo Heating Mantle (2010) – 6 place – 3 each

Vacuum Manifold – 6Place (2010) – for SPE

Gas Chromatograph - High Resolution Mass Spectrometer (GC/HRMS)

(HR1) Waters Autospec Premier (2009) – A GC-HRMS system with Masslynx Version 4.1 data acquisition & quantitation software. System includes an Agilent 7890A GC and 7683B autosampler.

Gas Chromatograph - Mass Spectrometers (GC/MS)

(NT2) Hewlett Packard (1999) – A GC-MS system networked with a Hewlett Packard Unix Server running Thruput Target 3.5 data analysis software. System includes Agilent 6890 GC, 5973 MSD, and 7683 autosampler.

(NT3) Hewlett Packard (1999) – A GC-MS system networked with a Hewlett Packard Unix Server running Thruput Target 3.5 data analysis software. System includes an HP 6890 Plus GC, an HP 5973 MSD, an OI Analytical Eclipse 4660 and a Varian Archon autosampler for VOA analysis of aqueous or solid samples.

(NT4) Hewlett Packard (2001) – A GC-MS system networked with a Hewlett Packard Unix Server running Thruput Target 3.5 data analysis software. The system includes HP 6890-Plus GC, 5973 MSD and 6890 autosampler

(NT5) Hewlett Packard (2002) – A GC-MS system networked with a Hewlett Packard Unix Server running Thruput Target 3.5 data analysis software. The system is equipped with an HP 6890N GC, an HP 5973N MSD, a Tekmar LCS 2000 Purge and Trap and a Dynatech PTA 30 autosampler for VOA analysis of aqueous or solid samples.

(NT6) Hewlett Packard (2002) – A GC-MS system networked with a Hewlett Packard Unix Server running Thruput Target 3.5 data analysis software. The system includes an HP 6890 Plus GC, an HP 5973 MSD and an HP 7683 autosampler.

(NT7) Hewlett Packard (2007) – A GC-MS system networked with a Hewlett Packard Unix Server running Thruput Target 3.5 data analysis software. The system is equipped with an HP 6890N GC, an HP 5973N MSD, a Tekmar LCS 2000 Purge and Trap and a Dynatech PTA 30 autosampler for VOA analysis of aqueous or solid samples.

(NT8) Agilent (2008) – A GC-MS system networked with a Hewlett Packard Unix Server running Thruput Target 3.5 data analysis software. The system is equipped with Agilent 6890N GC, 5975C MSD, and 7683 autosampler.

(NT9) Agilent (2008) – A GC-MS system networked with a Hewlett Packard Unix Server running Thruput Target 3.5 data analysis software. The system is equipped with Agilent 6890 GC and 5973 MSD, a Tekmar LSC 2000 Purge and Trap and a Dynatech PTA-30 autosampler for VOA analysis of either aqueous or solid samples.

(NT10) Agilent (2008) – A GC-MS system networked with a Hewlett Packard Unix Server running Thruput Target 3.5 data analysis software. The system is equipped with Aglient 6850GC,an Agilent 5975C inert MSD GC, an OI Analytical Eclipse 4660 and a Varian Archon autosampler for VOA analysis of aqueous samples.

(NT11) Hewlett Packard (2009) - A GC-MS system networked with a Hewlett Packard Unix Server running Thruput Target 3.5 data analysis software. The system includes an Agilent 6890 N GC, an HP 5973 MSD and a Combi-pal SPME autosampler.

(NT12) Hewlett Packard (2011) - A GC-MS system networked with a Hewlett Packard Unix Server running Thruput Target 3.5 data analysis software. The system includes an Agilent 6890 GC, an HP 5973N MSD and an HP G2614A autosampler.

Gas Chromatographs

Hewlett Packard 5890 Series II (2003) – A GC system equipped with both FID and ECD detectors, capillary injectors, an autosampler and Chemstation. Used for screening samples before full extraction.

(ECD1) Hewlett Packard 5890 Series II (2004) - A GC system equipped with dual ECD detectors, an Agilent 6890 autosampler and HP Chem Station data system.

(ECD3) Hewlett Packard 5890 Series II (1991) – A GC system equipped with Dual ECD detectors, two Cool on column capillary injectors, an HP7673 autosampler and ChromPerfect data system.

(FID2) Hewlett Packard 5890 Series II (2004) – A GC system equipped with an FID detector, a capillary injector, an HP 7673A autosampler and HP Chem Station data system.

(FID3 A, B) Hewlett Packard 6890 (1996) – A GC system equipped with dual FID detectors, two capillary injectors, a dual tower HP 6890 autosampler, and HP Chem Station data system. A Restek GC Racer has been added to enhanced performance.

(FID4 A, B) Hewlett Packard 6890 (1996) – A GC system equipped with dual FID detectors, two capillary injectors, a dual tower HP 6890 autosampler, and HP Chem Station data system. A Restek GC Racer has been added to enhanced performance.

(PID1) Hewlett Packard 5890 Series II (2002) – A GC system equipped PID and FID detectors in series, an Dynatech PT30 autosampler and Tekmar LCS 2000 Sample Concentrator and Chemstation data system.

(PID2) Hewlett Packard 5890 Series II – (2005) –A GC system equipped with dual PID detectors, one in series with an FID, a Dynatech PT30 autosampler, a Tekmar 2000 sample concentrator and HP Chem Station data system.

(PID 3) Hewlett Packard 5890 Series II – (2006) –A GC system equipped with PID and FID detectors in series, a Dynatech PT30 WS autosampler, a Tekmar 2000 sample concentrator and HP Chem Station data system.

(ECD5) Hewlett Packard 6890 Plus Micro – (2002) – A GC system equipped with dual ECD detectors, an HP 7683 autosampler and an HP Chem Station data system.

(ECD6) Hewlett Packard 6890 Plus Micro – (2008) – A GC system equipped with dual ECD detectors, an Agilent 6890 autosampler and an HP Chem Station data system.

(FID5) Hewlett Packard 5890E Series II (2005) – A GC system equipped with dual FID detectors, an HP 7683 autosampler and HP Chem Station data acquisition system.

(FID6) Hewlett Packard 5890 Series II (2005) – A GC system equipped with an FID detector, an HP 7694 Headspace Sampler and HP Chem Station data acquisition system.

(FID7) Agilent 6850 (2008) – A GC system equipped with a single FID detectors, an Agilent 6850 autosampler and HP Chem Station data acquisition system.

(ECD7) Hewlett Packard 6890 Plus Micro – (2008) – A GC system equipped with dual ECD detectors, an Agilent 6890 autosampler, and HP Chem Station data system.

(ECD8) Hewlett Packard 6890N – (2011) – A GC system equipped with dual ECD detectors, an Agilent 2614 autosampler, and HP Chem Station data system.

(FID8) Agilent 6890N (2008) – A GC system equipped with a dual FID detectors, an Agilent 7683B autosampler and HP Chem Station data acquisition system.

(FID9) Agilent 6850 (2009) – A GC system equipped with a single FID detector, an Agilent 6850 autosampler and HP Chem Station data acquisition system.

Inorganic Instrumentation

Perkin-Elmer SCIEX ELAN 6000 ICP-MS (1996) - A completely automated ICP-Mass Spectrometer with autosampler and multitasking software.

Perkin-Elmer NexIon 300D ICP-MS (2011) - A completely automated reaction cell & collision cell ICP-Mass Spectrometer with autosampler and multitasking software.

Perkin-Elmer Optima 7300DV ICP (2009) – Automated dual view simultaneous ICP with an Elemental Scientific SC-2 fast autosampler system

Perkin-Elmer Optima 4300 ICP (2001) - A completely automated dual view simultaneous ICP with auto-sampler and multitasking software.

Varian 300Z (1992) - A single channel atomic absorption graphite furnace instrument equipped with Zeeman background correction, and an auto-sampler

CETAC M-6000A Mercury Analyzer (2000) – A fully automated high sensitivity cold vapor atomic absorption instrument dedicated to trace and ultratrace Mercury analysis. System is computer controlled with windows base software and an auto-sampler

Dionex Ion Chromatography DX 500 (1997) – A fully automated system with an auto-sampler for quantitative anion analyses. The system is computer controlled using Peaknet software.

Dionex Ion Chromatography 2100 (2009) – A fully automated system with an auto-sampler for quantitative anion analyses. The system is computer controlled using Chromeleon CHM-2 Version 7.0 software.

Thermo Genesys 10 (2003) - UV-VIS Spectrophotometer used for quantitative conventionals analysis.

Thermo Genesys 10 (2005) - UV-VIS Spectrophotometer used for quantitative conventionals analysis.

Lachat QuickChem 8000 Flow Injection Analyzer (2003) – Automated flow injection instrument dedicated to low level nutrient analysis

Lachat QuickChem 8500 Flow Injection Analyzer (2007) – Automated flow injection instrument dedicated to low level nutrient analysis

Dohrmann Apollo 9000 (2001) - Total Organic Carbon (TOC) Analyzer. Includes an autosampler for water analysis and a boat sampler for solids analysis.

Dohrmann Apollo 9000 (2009) - Total Organic Carbon (TOC) Analyzer. Includes an autosampler for water analysis and a boat sampler for solids analysis.

Kontes Midi-Vap Cyanide Distillation Systems (3 each)(1995-2008) – Each of the systems is capable of simultaneously distilling up to 10 samples for cyanide analysis using small sample aliquots.

Centrifuge (1987) - Beckman Model GP with swinging bucket rotor and inserts for 250 ml bottles and scintillation vials

Aim 500 Block Digestion System (2006) with Controller

Environmental Express Hot Block digestion blocks (10 ea) (1999-2008) for digestion of samples prior to trace metals analysis.

Hach COD Digestion Blocks (2)

Hach Ratio Nephelometer

Incubators: Lab-Line Ambi Hi-Lo Chamber and **Thermolyne 41900.**

GeoTech Laboratory Equipment

Trautwein Sigma 1 (2008) – Triaxial loading system

Sedigraph III Model 5120 (2007) – Automatic particle size analyzer

Beckman Coulter LS 13320 (2008) – Laser diffraction particle size analyzer with microliquid and universal liquid modules

Trautwein Soil Equipment – 12 position flexible wall permeability station

Soil Test Load Frame – with 500, 2,000 and 10,000 pound load cells for QU, UU, and CU triaxial tests, with pore pressure.

Soil Consolidation Apparatus – 16 tsf

Biosciences BI-1000 – 8 position electrolytic respirometer

Microtox – photo-luminescence toxicity test instrument

Beckman JP-21 – refrigerated centrifuge with 6 x 500 ml fixed angle head

IEC DRP-6000 – refrigerated centrifuge with a 4 x 1,000 ml swinging bucket head

Plas-Labs Anaerobic Test Chambers – 3 each

U.S. Army Corps of Engineers – column settling; column and batch leaching apparatus

Network Servers

ARI's central laboratory computer is a Dell PC Server, PowerEdge 2300/450, running Microsoft Windows NT 4.0 SP6. This system is home to ARI's Laboratory Information Management System (LIMS) database developed by Northwest Analytical of Portland, OR. The LIMS receives electronic data from all lab sections and produces hardcopy and electronic deliverables. In addition, the LIMS stores sample demographic data while providing a common tracking mechanism for all laboratory information.

The LIMS is connected to two sub-networks. Most data, with the notable exception of Conventionals and Geotech, is transferred electronically as text files from other data systems to the LIMS. This key process enhances data integrity by reducing manual entry and manipulation of instrument output.

The metals section uses an Intel PC Server with the Windows 2000 Server operating system. This system runs as a file server for dBASE IV and MS Access 2000 database applications.

Once data is collected by the metals instrument computers, dBASE is used to aggregate and process the results and transfer it to the LIMS. The MS Access software has been customized by ARI's metals data supervisor to generate metals CLP forms and other internal reports. This server also provides additional services such as DHCP, WSUS, and the corporate vacation calendar.

The organics section uses an HP-UX Server with the HP-UX 10.20 operating system. This system runs Target 3.4 data analysis software. All GC/MS and other GC instruments are networked to this system. In addition to providing one common platform for organics data processing, the Target software produces CLP forms for organics data packages.

The conventional analysis laboratory uses individual PC Workstations with MS Excel for data reduction. Filled spreadsheets are saved to Server3. Data is manually copied from the MS Excel spreadsheet into the LIMS systems using LIMS worklists specific to a test method.

Server2 is the primary internal/external interface and provides email, NTP, web (internet and intranet), DHCP, proxy, document (Geotech), CVS, database, and authentication services. Access to Server2 is limited to authorized users and only IT personal have access to the shell.

Server3, running Windows 2000 Advanced Server, is the primary document server for ARI and is used to warehouse all scanned (pdf) data packages. The hardware for Server3 consists of a generic box with a 2.4 MHz Intel Pentium 4 processor. Packages saved to this server are indexed using the CI service of Windows and are available for searching via the ARI intranet.

All servers are secured in a locked room where only management and IT staff have access. Some users have external access to the network but this is limited to current employees and only through an end-to-end encrypted VPN (OpenVPN).

Note: Extensive in-house replacement parts are available for lab instruments and computers, including spare circuit boards. A majority of all service maintenance is performed by ARI employees.

Appendix E

ARI Active Standard Operating Procedures (SOP)

A list of ARI's current Standard Operating Procedures (SOPs) is available on ARI's web site at:

http://www.arilabs.com/portal/downloads/ARI-SOPs.zip

SOPs are updated periodically. Assure that you have ARI's current SOPs by downloading the files at the time of use.

Appendix F

Sample Containers, Preservation and Holding Times

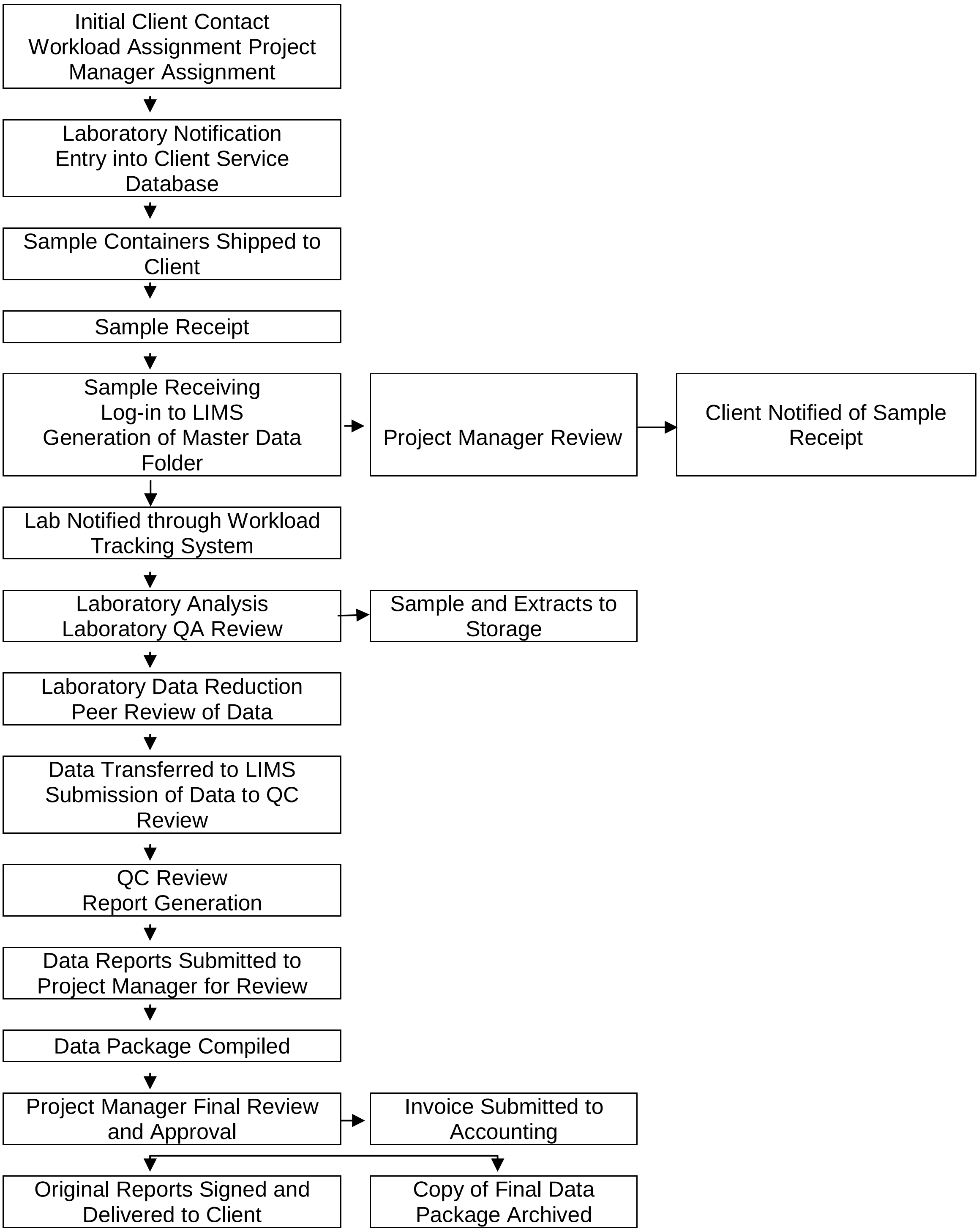
A summary of sample containers, preservatives and holding times is available on ARI's web site at:

http://www.arilabs.com/portal/downloads/

The summary is updated periodically. Assure that you have ARI's current document by downloading the files at the time of use.

Appendix G

Laboratory Workflow


Initial Client Contact
Workload Assignment Project Manager Assignment
Laboratory Notification
Entry into Client Service Database
Sample Containers Shipped to Client
Sample Receipt
Sample Receiving
Log-in to LIMS
Generation of Master Data Folder
Project Manager Review
Client Notified of Sample Receipt
Lab Notified through Workload Tracking System
Laboratory Analysis
Laboratory QA Review
Sample and Extracts to Storage
Laboratory Data Reduction
Peer Review of Data
Data Transferred to LIMS
Submission of Data to QC Review
QC Review
Report Generation
Data Reports Submitted to Project Manager for Review
Data Package Compiled
Project Manager Final Review and Approval
Invoice Submitted to Accounting
Original Reports Signed and Delivered to Client
Copy of Final Data Package Archived

Analytical Resources, Incorporated
Analytical Chemists and Consultants

Appendix H

Analytical Methods

ORGANIC ANALYSES

Parameter	Methods	Technique
Volatiles (GC/MS)	524.2/624/8260B	GC/MS
	Low Level Vinyl Chloride & 1,1 – Dichloroethene	GC-MS-SIM
Volatiles (GC)		
Volatile Aromatics	602/8021B	GC/PID
Semivolatiles (GC/MS)		
Semivolatile Organics	625/8270D	GC/MS
Polynuclear Aromatic Hydrocarbons (PNA/PAH)	625/8270D	GC/MS (SIM)
Isotope Dilution Semivolatiles	1625	GC/MS
Butyl Tin Species	Krone (1988)	GC/MS-SIM
Pesticides/GC Analyses		
Chlorinated Pesticides	608/8081A	GC/ECD
Aroclors/PCBs	608/8082	GC/ECD
PCB Congeners	ARI Method	GC/ECD
Phenols	604/8041	GC/FID
Chlorinated Phenols	8041 (mod)	GC/ECD
Pentachlorophenol	8151A (mod)	GC/ECD
Organophosphorous Pesticides	614/8141A	GC/NPD
Polynuclear Aromatic Hydrocarbons (PNA/PAH)	610/8100	GC/FID
Chlorinated Hydrocarbons	612/8121	GC/ECD
Herbicides	615/8151A	GC/ECD
Glycols	ARI Method(SOP 426S R2)	GC/FID
Hydrocarbon ID	NWTPH-HCID	GC/FID
Gasoline Range Hydrocarbons	(N)WTPH-G/AK101/WI-GRO	GC/FID
Diesel Range Hydrocarbons	(NWTPH-D/AK102/WI-DRO)	GC/FID
Extractable Petroleum Hydrocarbons	ARI Method	GC/FID
Volatile Petroleum Hydrocarbons	ARI Method	GC/PID

Organic Sample Preparation and Clean Up

TCLP / SPLP Extraction	1311 / 1312
Sonication	3550B
Soxhlet	3540C
Accelerated Solvent Extraction (ASE)	3545B
Separatory Funnel	3510C
Continuous Liquid-Liquid	3520C
Alumina Clean-up	3610B

Florisil Clean-up	3620B
Gel Permeation (GPC)	3640A
Silica Gel	3630C
Sulfur Clean-up	3660B
Sulfuric Acid Clean-up	3665A

INORGANIC ANALYSES

Parameter	Methods	Technique
Wet Chemistry		
Acidity	2310/305.1	Titrimetric
Alkalinity	2320/310.1	Titrimetric
Ammonia	4500NH_3H/350.1	AutomatedPhenate/ISE
Biological Oxygen Demand-BOD		
Carbonaceous – BOD	5210.B/405.1	5-day Winkler Titration
Bromide	4500Br.B	Phenol Red Colorimetric
Anions	300.0	Ion Chromatography
Cation Exchange Capacity	9080	Neutral Ammonium Acetate
Chemical Oxygen Demand	5220.D/410.4	Closed Reflux, Colorimetric
Chromium Hexavalent (Cr6+)	3500Cr-D/7196A	Diphenylcarbazide
Chloride	4500Cl.E/325.2	Automated Ferricyanide
Chlorophyll a	10200.H	Spectrophotometric
Coliform, Total / Fecal	9222.B/D	Membrane Filtration
Color	2120.B/110.2	Visual Comparison
Conductivity	2510/120.1	Electrometric
Corrosivity (CaCO3 Saturation)	2330	Calc. (pH, Alk, TDS, Ca)
Cyanide, Total	4500CN.C/335.2/9010	PBA, Colorometric
Cyanide, Amenable	4500CN.G/335.1	Alkaline Chlorination
Cyanide, WAD	4500CN.I	Weak Acid Distillation
Dissolved Oxygen	4500-O.C/360.2	Winkler Titration
Fats/Oils/Grease	5520.B/413.1/9070A	Gravimetric
Fluoride	4500F.C/340.2	Ion Specific Electrode
	300.0	Ion Chromatography
Formaldehyde	ASTM D-19 P216	Colorimetric
Hardness, Calculation	2340.B/6010B	Ca, Mg Calculation
Heterotrophic Plate Count	9215.D	Membrane Filtration
Iron (II) ferrous	3500Fe.D	Phenanthrolene
Nitrate + Nitrite	4500NO_3F/353.2	Automated Cd Reduction
Nitrate	4500NO_3F/353.2	Calculated
	300.0	Ion Chromatography
Nitrite	4500NO_3.F/353.2mod	Automated Colorimetric
	300.0	Ion Chromatography
Oil & Grease, Solids	5520.D/907	Gravimetric
Oil & Grease, Polar/Non Polar	5520.F	Gravimetric
PH	150.1	Electrometric
Phenols	5530.D/420.1/9065	4-AAP w/ Distillation
Phosphorous, Total	4500P.B/365.2	Colorimetric w/ digestion

Phosphorous, Ortho (SRP)	4500P.B/365.2	Colorimetric
	300.0	Ion Chromatography
Salinity	2520	Conductimetric
Silicate	4500Si.E/370.1	Heteropoly Blue
Total Kjeldahl Nitrogen (TKN)	4500N.org/351.4	Block Digest/ISE
Total Solids	2540.B/160.3	Gravimetric, 104^oC
Total Suspended Solids (TSS)	2540.D.160.2	Gravimetric, 104^oC
Total Dissolved Solids (TDS)	2540.C/160.1	Gravimetric, 180^oC
Total Volatile Solids (TVS)	2540.E/160.4	Gravimetric, 550^oC
Settleable Solids	2540.F	Volumetric
Streptococcus, Fecal	9230.C	Membrane Filtration
Sulfide	4500S^2.E/376.1/9034	Iodometric
Sulfide, Low Level	4500S^2.D/376.2	Methylene Blue
Sulfide, Acid Volatile	4500S^2.D/376.2	Methylene Blue
Sulfate	4500SO_4^2.F/375.2/9036	Auto. Methylthymol Blue
	300.0	Ion Chromatography
Sulfite	4500SO_3^2.B.377.1	Iodometric
Total Organic Carbon (TOC)	5310.B415.1/PSEP	Combustion NDIR
Turbidity	2130.B/180.1	Nephelometric
Total Lipids in Tissue	Bligh & Dyer (mod)	Gravimetric

Trace Metals Analyses

Inductively Coupled Plasma (ICP):		
Ag, Al, As, B, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Mo, Na, Ni, Pb, Sb, Se, Si, Sn, Sr, Th, Ti, Tl, V, (Li, Th, U, W - special request only)	Zn200.7 / 6010B	ICP
Graphite Furnace (GFAA):		
Ag, As, Cd, Sb, Pb, Se, Tl	200 Series / 7000 Series	GFAA
Cold Vapor (CVAA):		
Hg	7470A/7471A	CVAA
Inductively Coupled Plasma/Mass Spectroscopy (ICP-MS):		
Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Mo, Na, Ni, Pb, Sb, Se, Th, Tl, U, V, Zn	200.8/ 6020 Mod.	ICP/MS

Trace Metals Sample Preparation

Toxicity Characteristic Leaching Procedure	1311
Synthetic Precipitation Leaching Procedure	1312
Digestion for Total Recoverable or Dissolved Metals	3005A
Digestion of Aqueous Samples for Total Metals by ICP	3010A
Digestion of Aqueous Samples for Total Metals by GFAA	3020A
Digestion of Sediment, Sludge and Soil	3050B

Appendix I

Method Detection Limits and Reporting Limits

Summaries of method specific MDL studies and reporting limits are available on ARI's web site at:

http://www.arilabs.com/portal/downloads/ARI-MDLs.zip

MDL's and reporting are updated periodically. Assure that you have ARI's current detection limit data by downloading the files at the time of use.

Appendix J

Quality Control Recovery Limits

Method specific control limits are available on ARI's web site at:

http://www.arilabs.com/portal/downloads/ARI-CLs.zip

Control limits are updated periodically. Assure that you have ARI's current control limits by downloading the files at the time of use.

Analytical Resources, Incorporated
Analytical Chemists and Consultants

Appendix K

Internal Audit Schedule

Schedule of Laboratory Quality Assurance Audits

Process To Be Audited	**Frequency**
Verify Effectiveness of Corrective Actions	Monthly
Verify Refrigerator and Freezer Temperature Logs	Monthly*
Verify Oven and Incubator Temperature Logs	Monthly*
Verify That Balance Records Are Complete	Quarterly*
Verify That Standard Records are Complete	Monthly#
Verify That Logbooks Are Reviewed	Monthly#
Verify That SOPs Are Current and Available in Labs	Monthly#
Review Chain of Custody Documentation	Monthly#
Audit Internal Technical Systems	Annually
Post-Completion Project Review	Monthly**

* all sections will be audited

one section will be audited each month

** frequency may be contract specific i.e. 10% of NFESC projects must be audited

Appendix L

Laboratory Accreditations

Laboratory Accreditations

Analytical Resources Inc. is currently certified to perform environmental analysis by the National Environmental Laboratory Accreditation Program (NELAP), the State of Washington Department of Ecology and the State of Alaska Department of Environmental Conservation. ARI is approved to perform analyzes for the US Navy and the US Army Corps of Engineers following the Department of Defense Quality Systems Manual (DoD-QSM)

ARI's laboratory QA/QC Program has been audited and approved by The Boeing Company and Battelle Pacific Northwest Laboratories.

ARI analyzes drinking water, waste water and solid matrix performance testing (PT) samples semiannually.

List of Accreditations

1) National Environmental Laboratory Accreditation Conference (NELAC) – Accrediting authority is Oregon Environmental Laboratory Accreditation Program (ORELAP).
2) State of Washington, Department of Ecology - Environmental Laboratory Accreditation Program
3) The Alaska State Department of Environmental Conservation - Laboratory Approval Program
4) United States Army Corps of Engineers (USACE)
5) United States Naval Facilities Engineering Service Center (NFESC) (formerly known as NEESA)

Continuing Contracts Resulting from On-Site Laboratory Audits

1) The Boeing Company Corporate Environmental Affairs Division
2) The City of Seattle
3) The Port of Seattle

Appendix M

Data Reporting Qualifiers

Analytical Resources, Incorporated
Analytical Chemists and Consultants

Data Reporting Qualifiers

Effective 7/10/2009

Inorganic Data

U Indicates that the target analyte was not detected at the reported concentration

* Duplicate RPD is not within established control limits

B Reported value is less than the CRDL but ≥ the Reporting Limit

N Matrix Spike recovery not within established control limits

NA Not Applicable, analyte not spiked

H The natural concentration of the spiked element is so much greater than the concentration spiked that an accurate determination of spike recovery is not possible

L Analyte concentration is ≤5 times the Reporting Limit and the replicate control limit defaults to ±1 RL instead of the normal 20% RPD

Organic Data

U Indicates that the target analyte was not detected at the reported concentration

* Flagged value is not within established control limits

B Analyte detected in an associated Method Blank at a concentration greater than one-half of ARI's Reporting Limit or 5% of the regulatory limit or 5% of the analyte concentration in the sample.

J Estimated concentration when the value is less than ARI's established reporting limits

D The spiked compound was not detected due to sample extract dilution

E Estimated concentration calculated for an analyte response above the valid instrument calibration range. A dilution is required to obtain an accurate quantification of the analyte.

Q Indicates a detected analyte with an initial or continuing calibration that does not meet established acceptance criteria (<20%RSD, <20%Drift or minimum RRF).

S Indicates an analyte response that has saturated the detector. The calculated concentration is not valid; a dilution is required to obtain valid quantification of the analyte

NA The flagged analyte was not analyzed for

NR Spiked compound recovery is not reported due to chromatographic interference

NS The flagged analyte was not spiked into the sample

M Estimated value for an analyte detected and confirmed by an analyst but with low spectral match parameters. This flag is used only for GC-MS analyses

M2 The sample contains PCB congeners that do not match any standard Aroclor pattern. The PCBs are identified and quantified as the Aroclor whose pattern most closely matches that of the sample. The reported value is an estimate.

N The analysis indicates the presence of an analyte for which there is presumptive evidence to make a "tentative identification"

Y The analyte is not detected at or above the reported concentration. The reporting limit is raised due to chromatographic interference. The Y flag is equivalent to the U flag with a raised reporting limit.

EMPC Estimated Maximum Possible Concentration (EMPC) defined in EPA Statement of Work DLM02.2 as a value "calculated for 2,3,7,8-substituted isomers for which the quantitation and /or confirmation ion(s) has signal to noise in excess of 2.5, but does not meet identification criteria" **(Dioxin/Furan analysis only)**

C The analyte was positively identified on only one of two chromatographic columns. Chromatographic interference prevented a positive identification on the second column

P The analyte was detected on both chromatographic columns but the quantified values differ by ≥40% RPD with no obvious chromatographic interference

X Analyte signal includes interference from polychlorinated diphenyl ethers. **(Dioxin/Furan analysis only)**

Z Analyte signal includes interference from the sample matrix or perfluorokerosene ions. **(Dioxin/Furan analysis only)**

Geotechnical Data

A The total of all fines fractions. This flag is used to report total fines when only sieve analysis is requested and balances total grain size with sample weight.

F Samples were frozen prior to particle size determination

SM Sample matrix was not appropriate for the requested analysis. This normally refers to samples contaminated with an organic product that interferes with the sieving process and/or moisture content, porosity and saturation calculations

SS Sample did not contain the proportion of “fines” required to perform the pipette portion of the grain size analysis

W Weight of sample in some pipette aliquots was below the level required for accurate weighting

Appendix N

Standards for Personal Conduct

Standards of Conduct

Since effective working relationships depend upon each of us, ARI expects certain minimum standards of personal conduct.

This list highlights general Company expectations and standards and does not include all possible offenses or types of conduct which may result in discipline or discharge. Management reserves the absolute right to determine the appropriate degree of discipline, including discharge, warranted in individual cases.

Employees engaged in the following activities, or similar activities deemed equally serious, will normally be terminated:

theft or embezzlement
disclosure of trade secrets or industrial espionage;
willful violation of safety or security regulations;
conviction of a felony;
working for a competitor or establishing a competing business.

In addition, dismissal may result from other serious offenses such as:

being intoxicated, under the influence or in possession of illegal drugs on the job;
falsification of records;
abuse, destruction, waste or unauthorized use of equipment, facilities or materials;
gambling on the premises;
chronic tardiness or absenteeism;
insubordination;
unwillingness to perform the job;
unauthorized requisition of materials from vendors.

There may be no alcoholic beverages on the Company premises, other than at times designated as Company functions. At such times, non-alcoholic beverages will be provided as well.

Personal and corporate honesty and integrity have built the character of ARI. This good character is fundamental to our well-being, future growth and progress. It is vitally important that we avoid both the fact and the appearance of conflicts of personal interest with that of the firm, its clients, and any other professional contacts.

This policy requires that ARI employees have no relationships or engage in any activities that might impair their independence of judgment. Employees must not accept gifts, benefits, or hospitality that might tend to influence them in the performance of their duties. It is expected that there will be no employment by any competing company, nor any employment by any outside interest or engagement in outside activity which might impair an employee's ability to render the full-time service to the company that employment involves.

If any possible conflict of interest situation arises, the individual concerned must make prior disclosure of the facts so that action may be taken to determine whether a problem exists and,

Standards of Personnel Conduct – continued

if so, how best to eliminate it. Likewise, any financial interest in an organization doing business with ARI or which competes with us should be revealed to Company management. (Excluded from this requirement is ownership of securities traded in major stock exchanges or other recognized trading markets.)

Our standards are those generally expected of employees in any well-regarded, ethical business organization.

ARI further expects that each employee will:

Be dressed and groomed appropriately for a business office. Employees in the laboratory areas are expected to dress in compliance with established safety procedures. Specific standards will be discussed with each employee during Health and Safety orientation. Your supervisor and the Administrative Services Manager always are available to answer questions.

Maintain the confidential nature of Company information. Removal of Company documents, records, stored materials, computer printouts, or any similar information, or copies of such material or information from the office without specific permission is prohibited. Likewise, revealing confidential information to an unauthorized person or using such information in an unauthorized way is prohibited. If there could be any possible question about the applicability of this requirement to a given circumstance, ask your supervisor.

Use Company computer capabilities and facilities only for authorized business at authorized times and locations; observe strictly all computer security measures and precautions; enter, alter or delete no computer instructions or stored material apart from that required by faithful performance of assigned duties; remove, copy, use or permit to be used no computer software developed for, purchased by, or otherwise used by ARI except as required by faithful performance of assigned duties.

Conduct business dealings with clients and members of the public in a courteous manner.

Appendix O

Quality Assurance Policies

QUALITY ASSURANCE POLICY

POLICY NUMBER:	**1**
SUBJECT:	**CORRECTIONS TO DATA/BENCHSHEETS**
DATE:	**8/2/96**

Manual corrections made on any raw data, bench sheet, logbook or document used during sample processing will be made in the following manner:

1. Draw a single line through the information to be deleted or corrected. The original information must remain readable.

2. Enter any new information, preferably above the original information.

3. Initial and date the correction.

Analytical Resources, Incorporated
Analytical Chemists and Consultants

QUALITY ASSURANCE POLICY

POLICY NUMBER: **2**

SUBJECT: **LINING OUT UNUSED BENCHSHEET PORTIONS**

DATE: **8/2/96**

All unused portions of logbook pages and benchsheets will be lined through so that information cannot be added at a later date. This will be completed in the following manner:

1. Line out unused portions of a logbook page or benchsheet by drawing a single line or "Z" through the unused portions.

2. Initial and date the page beside the lineout.

3. Do not line out a page or section until it is certain that no additional information will be added to the unused portions.

QUALITY ASSURANCE POLICY

POLICY NUMBER: 3

SUBJECT: STOP WORK ORDERS

DATE: 8/28/96

It is the responsibility of all staff members to address situations that may require the issuance of a "stop work order". Potential and actual "stop work orders" will be handled as follows:

1. If an analyst or technician observes a situation which will or may have a negative impact on data quality, that person will notify her/his section supervisor immediately.

2. The section supervisor will assess the situation. If it appears that a "stop work order" may be required, the section supervisor will notify the appropriate manager (inorganic or organic).

3. The supervisor and manager will then decide if a "stop work order" should be issued. The manager will make a final decision on whether or not to issue a "stop work order". The incident will be reported to the Quality Assurance Program Manager using a Corrective Action Request form.

4. If a "stop work order" is issued, the manager will inform the Project Managers and the QA section. The section supervisor will notify section staff of the order.

5. The laboratory manager involved will oversee the development and implementation of a Corrective Action Plan (CAP). Upon completion of the CAP the "stop work order" may be rescinded.

6. Prior to rescinding a "stop work order", verification must be made that control has been regained and that work may begin. Only the inorganic or organic manager may rescind a "stop work order".

7. When the "stop work order" is rescinded, the Project Managers, analytical staff and QA section will be notified. The QA section will require documentation verifying that the procedure is back in control.

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QUALITY ASSURANCE POLICY

POLICY NUMBER: **4**

SUBJECT: **SOP Review**

DATE: **9/3/96**

All Standard Operating Procedure (SOP) documents will be reviewed and updated at least annually by qualified staff members. Laboratory management will review and approve all modifications to the SOPs.

QUALITY ASSURANCE POLICY

POLICY NUMBER: **5**

SUBJECT: **Reporting Dilutions**

DATE: **9/11/96**

Dilution factors will be recorded as whole numbers followed by "X" (i.e., 5X, 10X, etc.). This reporting convention will be used on run logs, bench sheets, raw data and final reports for all diluted samples, extracts or digestates or standards.

QUALITY ASSURANCE POLICY

POLICY NUMBER: 6

SUBJECT: Formatting for SOPs – Computer Related

DATE: 1/31/00

Conventions for formatting computer-related instructions in SOPs

Commands should be indented and formatted as **`bold courier`** and one or two font sizes smaller:

```
USE PARAMS ORDER PARAMS
BROW
```

Many systems and languages are *case-sensitive*, and case should match the syntax and/or stylistic standards of the language.

If only one command, like ***`SET CENTURY ON`***, is needed, it can be included in the rest of the text, so long as it is also italicized.

If the user must substitute a particular value in place of a general descriptor, italicize the descriptor, make it lowercase, and *do not make it bold*:

```
USE PARAMS ORDER PARAMS
COPY TO TEMPARM FOR JOB = 'job' .AND. SAMPLE = 'sample'
```

In general, keywords, variable names, formatting codes, and descriptors should be in `courier` and *`italicized`*.

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QUALITY ASSURANCE POLICY

POLICY NUMBER:	**7**
SUBJECT:	**Manual Adjustment of Data**
DATE of IMPLEMENTATION:	**1/1/01**

Modern chromatographic instruments include computer software to identify a detector response as a chromatographic peak, characterize that peak and determine the relative height or area of the signal. The software utilizes parameters (threshold, slope, etc) that are adjusted by the instrument operator to optimize the results.

A single set of operator controlled settings that determine peak characteristics for an entire data file is defined as an "automated procedure". An automated procedure often characterizes chromatographic peaks incorrectly. ARI requires that trained analysts identify and resolve these errors using an alternate automated procedure or a "manual adjustment" of the data. Manual adjustment is defined as the process used by an analyst to adjust an individual peak or a subset of data in a chromatographic file.

1. The settings for a routine automated procedure normally used to process chromatographic data must be described in the method Standard Operating Procedure (SOP).

2. Trained analysts may substitute one automated procedure for another in order to optimize peak characteristics. The use of an alternate automated procedure must be permanently documented using either a software generated log file or analyst notes.

3. Manual adjustment of chromatographic peak characteristics will be used to correct the results of an automated procedure that, in a trained analyst's opinion, are clearly incorrect and will result in erroneous peak identification, integration or quantification.

4. Manual adjustment will be implemented in a reasonable and consistent manner. Guidelines for performing manual adjustment will be documented in method SOPs.

5. All manually adjusted data will be clearly identified for approval in the data review process. A permanent record of all manual adjustments will be maintained in both electronic and hardcopy versions of the raw data.

6. Manual adjustment of chromatographic files will not be used to falsify data for any purpose. Falsification of data through the use of manual peak adjustment is unethical, unlawful and will result in termination of the offending analyst.

Approval:

Quality Assurance Program Manager Date

QUALITY ASSURANCE POLICY

POLICY NUMBER:	**8**
SUBJECT:	**Performance Evaluation Samples**
IMPLEMENTATION DATE:	**1/1/01**

Performance Evaluation Samples (PES) will be analyzed on a periodic basis to monitor laboratory performance and/or meet the requirements of an external accreditation program. PES samples contain target analytes in concentrations unknown to laboratory personnel. PES may be submitted by a third party or prepared internally under the direction of ARI's QA personnel.

PES will be submitted blind to the laboratory whenever possible.

PES will be logged-in, prepared, analyzed and reported as a routine sample without special consideration.

Analytical Resources, Incorporated
Analytical Chemists and Consultants

QUALITY ASSURANCE POLICY

POLICY NUMBER:	**9**
SUBJECT:	**Modifications to Analytical Methods Procedures or Reports**
DATE of IMPLEMENTATION:	**8/24/05**

This Policy defines the processes used to initiate and validate modifications to analytical processes, QA/QC protocol, data processing programs and algorithms, data reporting formats or other changes to analytical procedures or SOPs at Analytical Resources Inc. (ARI). The procedures outlined will also be used to validate project specific changes to analytical protocol and new analytical methods.

Changes to analytical procedures must be approved by ARI's Management (Managers and/or Supervisors) and be well documented using the following procedure:

1. Modification may be requested by any staff member. The modification must be requested using ARI's Corrective Actions Tracking System. Corrective Action requests for changes to analytical protocol or reports will assigned to the appropriate manager or supervisor by the initiator. As an alternative the request may be assigned to the QA Section. The Corrective Actions assignee may approve the project or re-assign the request for approval to a third party. The QA Section will monitor the progress of all requests.

2. The requestor must detail and justify the proposed modifications or additions when initiating a Corrective Action issue. Modifications must be approved by ARI management prior to any work performed to establish the modification.

3. The following must be in place before final approval and/or implementation of the proposed modification.

   A. A new or revised SOP as appropriate including the modification or new protocol.
   B. An Initial Demonstration of Proficiency as defined in ARI SOP 1018S for new or modified analytical procedures.
   C. An MDL study following the procedure in ARI SOP 1018S for new or modified analytical procedure.
   D. When appropriate, successful analysis of a blind Performance Evaluation Sample using new or modified procedures or data processing protocol.
   E. Documentation that new or modified software provides the desired result.

4. ARI staff must have sufficient training to implement the procedural changes.

5. Notification of the modifications must be distributed to all affected personnel including appropriate client personnel.

Analytical Resources, Incorporated
Analytical Chemists and Consultants

QUALITY ASSURANCE POLICY

POLICY NUMBER:	**10**
SUBJECT:	**Reporting of Target and Spiked Analytes For Dual Column GC Analyses**
DATE of IMPLEMENTATION:	**8/24/05**

Analytical Resources Inc. uses single injection, dual column gas chromatographs to simultaneously identify and confirm the presence of target or spiked analytes in some GC analyses. Only one quantitative value is reported for each target or spiked analyte. ARI's policy for deciding which value to report is outlined as follows:

1. ARI considers each column equally valid for compound identification and quantification. Both GC columns must be compliant with all quality assurance parameters outlined in ARI's SOPs and LQAP. Both GC columns must produce valid initial and continuing calibrations using the same calibration model.

2. The analytical value reported will be determined by comparison of the quantitative results of confirmed analytes as follows.

a. The relative percent difference (RPD) between the results on the two columns (R_1 & R_2) is calculated using the formula:

$$RPD = \frac{|R_1 - R_2|}{\left(\frac{R_1 + R_2}{2}\right)} \times 100$$

b. If the RPD is less than 40% the greater of the two values is reported for both target analytes and spiked compounds. When required by specific QA protocol, by contract or client request the lower value will be reported for target analytes.

c. If the RPD is greater than 40%, ARI's analyst must examine the chromatogram for anomalies (overlapping peaks, incorrect integration, negative peaks) and either correct the anomalies (i.e. perform manual integrations) or report the most appropriate target analyte value. The higher value will be reported for spiked analytes. ARI's analyst must provide a written evaluation of all analyses where an RPD exceeds 40% and this information must be passed on to ARI's client or the data user.

Analytical Resources, Incorporated
Analytical Chemists and Consultants

QUALITY ASSURANCE POLICY

POLICY NUMBER:	**11**
SUBJECT:	**Calculation of Analytical Uncertainty**
DATE of IMPLEMENTATION:	**8/31/06**

Analytical Resources Inc. will use the procedure[1] proposed by Thomas Georgian, PhD to estimate analytical uncertainty. Dr. Georgian's proposes using the formulae below to calculate uncertainty:

For biased corrected analytical results:

100 (c/R)(1± L / R)
Where:
c = Measured concentration of the analyte
R = Average LCS spike recovery
L = ½ the warning or control range

And for unbiased results i.e. R = 100

c (± L / 100)

Example:

For a 10 ppb analytical result when the mean LCS recovery is 50% and the control limits are 20% to 80% an interval for the analytical results is calculated as follows:

100 (10 ppb / 50)(1±30 / 50) = 20 ± 12 ppb

[1] Estimation of Laboratory Analytical Uncertainty Using Laboratory Control Samples, Thomas Georgian, Ph.D., *Environmental Testing & Analysis*, November/December 2000.

Analytical Resources, Incorporated
Analytical Chemists and Consultants

QUALITY ASSURANCE POLICY

POLICY NUMBER:	**12**
SUBJECT:	**Rounding of Numbers and Reporting Limits**
DATE of IMPLEMENTATION:	**8/24/05**

I. ARI reports analytical results in concentration units as follows:

A. Values expressed as a concentration (mg/L, µg/Kg etc.)

1. Values less than or equal 10 are reported using 2 significant figures.
2. Values greater than 10 are reported using 2 or 3 significant figures.

B. Values expressed as percent (control limits, RSD etc.) are reported using the appropriate whole number. Examples: 6.38 rounds to 6, 9.95 rounds to 10, 99.93 rounds to 100, 145.48 rounds to 145.

II. ARI rounds numbers to the appropriate level of precision using the following rules:

A. If the figure following those to be retained is greater than or equal to 5, the absolute value of the result is to be rounded up: otherwise, the absolute value of the result is rounded down. Examples: -0.4365 rounds to -0.437 and 2.3564 rounds to -2.356; 11.443 is rounded down to 11.44 and 11.455 is rounded up to 11.46.

B. When a series of multiple operations is performed (add, subtract, divide, multiply), all significant figures are carried through the calculations and the final result is rounded to the appropriate number of significant figures.

III. ARI compares concentration values to reporting limits prior to rounding final concentration values. Example: with an RL of 0.50, 0.499 is undetected at 0.50 (0.50U) and 0.504 is detected at 0.50.

III. ARI will round quality control results prior to determining if the value is in control. Example: for spike recovery limits of ± 10% (90 – 110%), a recovery of 110.47is in control at 110% and a calculated recovery of 110.50 is out of control at 111%.

Analytical Resources, Incorporated
Analytical Chemists and Consultants

QUALITY ASSURANCE POLICY

POLICY NUMBER:	**12**
SUBJECT:	**Use of "J" Flag when Reporting Analytical Data**
DATE of IMPLEMENTATION:	**3/1/09**

1. ARI uses a "J" flag to indicate that a quantitative result chemical analysis is an estimated value. In general, "J" flags note positively identified compounds that are not in an instrument's verified calibrated range.
2. A "J" indicates quantitative values with a high degree of uncertainty. Data users must consider the greater uncertainty when using "J" flagged quantitative values.
3. ARI will not use "J" flags when reporting the results of metals analyses. Instrumental analysis of metals is subject to inter-element interference, non-specific absorption and sample-to-sample carryover that make quantification of elements below the reporting limit difficult. MDL studies performed on clean sample matrices are not subject to these interferences.
4. ARI will not report analytes below the RL ("J" flag is not used) for any single column GC analysis. (HCID, TPH-D, BTEX, TPH-G, RSK-175, Direct Aqueous Injection)
5. ARI uses "J" flags when reporting results of GC-MS (VOA and SVOA) and dual column GC analyses using the following criteria:
   A. All analyses must meet ARI established QA criteria for calibration and spike recovery.
   B. Analytes must meet method specific identification criteria (i.e. spectral match, retention time and/or relative retention time).
   C. The analyte concentration must exceed the greater of either the MDL or ½ the reporting limit before a "J" flag is applied.
   D. An analyte in a method blank will be "J" flagged only when any associated sample contains the same analyte.
   E. The application of a "J" flag is discretionary, depending on the professional judgment of ARI's data reviewers. GC-MS parameters such as ion ratios, spectral match, background contamination and instrument noise are weighted when considering the application of "J" flags.
6. Some typical circumstances that may warrant the use of a "J" flag:
   A. A compound identified at a concentration between the MDL or ½ RL and ARI's reporting limit (normally the low concentration used to calibrate the instrument).
   B. The quantified values in a dual column GC analysis differ by > 40% with obvious interference on one column. ARI may report the value with the lowest concentration or the least interference.
   C. The analyte is present at low concentration due to extract dilution and identified in a previous analysis of less dilute extract.
   D. Analytes < the RL and reported in previous analyses from the same sampling site.
   E. An analyte is < the RL in a sample and greater than the RL a duplicate or replicate analysis. This often applies to Matrix Spike and Laboratory Control Samples and their duplicates.

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
PO Box 488 • Manchester, WA 98353-0488 • (360) 871-8840

June 26, 2014

Mr. Dave Mitchell
Analytical Resources, Incorporated
4611 South 134th Place, Ste 100
Tukwila, WA 98168-3240

Dear Mr. Mitchell:

Thank you for your application for renewal in the Environmental Laboratory Accreditation Program. Enclosed is a Certificate of Accreditation covering the one-year period beginning July 1, 2014 and a current Scope of Accreditation.

Renewal of accreditation is based in part on review of your lab's performance over the past year as evidenced by participation in proficiency testing (PT) studies.

Accreditation has been granted for requested new methods, where those methods are approved for use in the matrix of interest. The methods listed on your Scope are those approved at 40CFR 136.3 or 141.23. Accreditation is not available for the requested sample preparation methods.

As a reminder, continued participation in the Ecology Lab Accreditation Program requires the lab to:

- Submit a renewal application and fees annually
- Report significant changes in facility, personnel, analytical methods, equipment, the lab's quality assurance (QA) manual or QA procedures as they occur
- Participate in proficiency testing studies semi-annually, with the following exception: **For each parameter where all PT results were satisfactory, you are required to submit only one PT result over this next year, and in subsequent years, as long as the results are satisfactory.**
- Submit copies of current third-party Scopes of Accreditation when they are available.

YOUR RIGHT TO APPEAL

You have a right to appeal Ecology's decision to the Pollution Control Hearing Board (PCHB) within 30 days of the date of receipt of this decision letter. The appeal process is governed by Chapter 43.21B RCW and Chapter 371-08 WAC. "Date of receipt" is defined in RCW 43.21B.001(2).

To appeal you must do the following within 30 days of the date of receipt of this decision:

- File your appeal and a copy of this decision with the PCHB (see addresses below). Filing means actual receipt by the PCHB during regular business hours.
- Serve a copy of your appeal and this decision on Ecology in paper form - by mail or in person. (See addresses below.) E-mail is not accepted.

You must also comply with other applicable requirements in Chapter 43.21B RCW and Chapter 371-08 WAC.

ADDRESS AND LOCATION INFORMATION

Street Addresses	Mailing Addresses
Department of Ecology Attn: Appeals Processing Desk 300 Desmond Drive SE Lacey, WA 98503 **Pollution Control Hearings Board** 1111 Israel Road SW STE 301 Tumwater, WA 98501	**Department of Ecology** Attn: Appeals Processing Desk PO Box 47608 Olympia, WA 98504-7608 **Pollution Control Hearings Board** PO Box 40903 Olympia, WA 98504-0903

If you have any questions concerning the accreditation of your lab, please contact me at (360) 871-8844, fax (360) 871-8849, or by e-mail at alan.rue@ecy.wa.gov.

Sincerely,

Alan D. Rue
Lab Accreditation Unit Supervisor

The State of Washington

Department of Ecology

Analytical Resources, Incorporated

Tukwila, WA

has complied with provisions set forth in Chapter 173-50 WAC and is hereby recognized by the Department of Ecology as an ACCREDITED LABORATORY for the analytical parameters listed on the accompanying Scope of Accreditation. This certificate is effective July 1, 2014 and shall expire June 30, 2015.

Witnessed under my hand on June 26, 2014

Alan D. Rue
Lab Accreditation Unit Supervisor

Laboratory ID
C558

WASHINGTON STATE DEPARTMENT OF ECOLOGY

ENVIRONMENTAL LABORATORY ACCREDITATION PROGRAM

SCOPE OF ACCREDITATION

Analytical Resources, Incorporated

Tukwila, WA

is accredited for the analytes listed below using the methods indicated. Full accreditation is granted unless stated otherwise in a note. Accreditation for U.S. Environmental Protection Agency (EPA) "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods" (SW-846) is for the latest version of the method. SM refers to EPA approved editions of "Standard Methods for the Examination of Water and Wastewater." ASTM is the American Society for Testing and Materials. Other references are described in notes.

Matrix/Analyte	Method	Notes
Drinking Water		
Turbidity	EPA 180.1_2_1993	
Bromide	EPA 300.0_2.1_1993	
Chloride	EPA 300.0_2.1_1993	
Fluoride	EPA 300.0_2.1_1993	
Nitrate	EPA 300.0_2.1_1993	
Nitrite	EPA 300.0_2.1_1993	
Orthophosphate	EPA 300.0_2.1_1993	
Sulfate	EPA 300.0_2.1_1993	
Color	SM 2120 B-01	5
Turbidity	SM 2130 B-01	
Alkalinity	SM 2320 B-97	
Hardness (calc.)	SM 2340 B-97	
Specific Conductance	SM 2510 B-97	
Solids, Total Dissolved	SM 2540 C-97	
Bromide	SM 4110 B-00	
Chloride	SM 4110 B-00	
Fluoride	SM 4110 B-00	
Nitrate	SM 4110 B-00	
Nitrite	SM 4110 B-00	
Orthophosphate	SM 4110 B-00	
Sulfate	SM 4110 B-00	
Cyanide, Total	SM 4500-CN^- E-99	

Matrix/Analyte	Method	Notes
Cyanide, Total	SM 4500-CN⁻ E-99	
pH	SM 4500-H+ B-00	8
Ammonia	SM 4500-NH3 D-97	
Orthophosphate	SM 4500-P E-99	
Dissolved Organic Carbon	SM 5310 B-00	
Total Organic Carbon	SM 5310 B-00	
Aluminum	EPA 200.7_4.4_1994	
Barium	EPA 200.7_4.4_1994	
Beryllium	EPA 200.7_4.4_1994	
Cadmium	EPA 200.7_4.4_1994	
Calcium	EPA 200.7_4.4_1994	
Chromium	EPA 200.7_4.4_1994	
Copper	EPA 200.7_4.4_1994	
Iron	EPA 200.7_4.4_1994	
Magnesium	EPA 200.7_4.4_1994	
Manganese	EPA 200.7_4.4_1994	
Nickel	EPA 200.7_4.4_1994	
Silver	EPA 200.7_4.4_1994	
Sodium	EPA 200.7_4.4_1994	
Zinc	EPA 200.7_4.4_1994	
Aluminum	EPA 200.8_5.4_1994	
Antimony	EPA 200.8_5.4_1994	
Arsenic	EPA 200.8_5.4_1994	
Barium	EPA 200.8_5.4_1994	
Beryllium	EPA 200.8_5.4_1994	
Cadmium	EPA 200.8_5.4_1994	
Chromium	EPA 200.8_5.4_1994	
Copper	EPA 200.8_5.4_1994	
Iron	EPA 200.8_5.4_1994	
Lead	EPA 200.8_5.4_1994	
Magnesium	EPA 200.8_5.4_1994	
Manganese	EPA 200.8_5.4_1994	
Nickel	EPA 200.8_5.4_1994	
Selenium	EPA 200.8_5.4_1994	
Silver	EPA 200.8_5.4_1994	
Thallium	EPA 200.8_5.4_1994	

Matrix/Analyte	Method	Notes
Zinc	EPA 200.8_5.4_1994	
Mercury	EPA 245.1_3_1994	
1,1,1,2-Tetrachloroethane	EPA 524.3_1.0_2009	
1,1,1-Trichloroethane	EPA 524.3_1.0_2009	
1,1,2,2-Tetrachloroethane	EPA 524.3_1.0_2009	
1,1,2-Trichloroethane	EPA 524.3_1.0_2009	
1,1-Dichloroethane	EPA 524.3_1.0_2009	
1,1-Dichloroethylene	EPA 524.3_1.0_2009	
1,1-Dichloropropene	EPA 524.3_1.0_2009	
1,2,3-Trichlorobenzene	EPA 524.3_1.0_2009	
1,2,3-Trichloropropane	EPA 524.3_1.0_2009	
1,2,4-Trichlorobenzene	EPA 524.3_1.0_2009	
1,2,4-Trimethylbenzene	EPA 524.3_1.0_2009	
1,2-Dibromo-3-chloropropane (DBCP)	EPA 524.3_1.0_2009	
1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA 524.3_1.0_2009	
1,2-Dichlorobenzene	EPA 524.3_1.0_2009	
1,2-Dichloroethane (Ethylene dichloride)	EPA 524.3_1.0_2009	
1,2-Dichloropropane	EPA 524.3_1.0_2009	
1,3,5-Trimethylbenzene	EPA 524.3_1.0_2009	
1,3-Butadiene	EPA 524.3_1.0_2009	
1,3-Dichloropropane	EPA 524.3_1.0_2009	
1,4-Dichlorobenzene	EPA 524.3_1.0_2009	
1-Chlorobutane	EPA 524.3_1.0_2009	
2-Chlorotoluene	EPA 524.3_1.0_2009	
4-Chlorotoluene	EPA 524.3_1.0_2009	
4-Isopropyltoluene (p-Cymene)	EPA 524.3_1.0_2009	
Allyl chloride (3-Chloropropene)	EPA 524.3_1.0_2009	
Benzene	EPA 524.3_1.0_2009	
Bromobenzene	EPA 524.3_1.0_2009	
Bromochloromethane	EPA 524.3_1.0_2009	
Bromodichloromethane	EPA 524.3_1.0_2009	
Bromoform	EPA 524.3_1.0_2009	
Carbon disulfide	EPA 524.3_1.0_2009	
Carbon tetrachloride	EPA 524.3_1.0_2009	
Chlorobenzene	EPA 524.3_1.0_2009	
Chlorodibromomethane	EPA 524.3_1.0_2009	

Matrix/Analyte	Method	Notes
Chlorodifluoromethane (Freon-22)	EPA 524.3_1.0_2009	
Chloroform	EPA 524.3_1.0_2009	
cis & trans-1,2-Dichloroethene	EPA 524.3_1.0_2009	
cis-1,2-Dichloroethylene	EPA 524.3_1.0_2009	
cis-1,3-Dichloropropene	EPA 524.3_1.0_2009	
cis-2-Octene	EPA 524.3_1.0_2009	
Dibromomethane	EPA 524.3_1.0_2009	
Dichlorodifluoromethane (Freon-12)	EPA 524.3_1.0_2009	
Diethyl ether	EPA 524.3_1.0_2009	
Di-isopropylether (DIPE)	EPA 524.3_1.0_2009	
Ethyl methacrylate	EPA 524.3_1.0_2009	
Ethyl tert-Butyl alcohol	EPA 524.3_1.0_2009	
Ethylbenzene	EPA 524.3_1.0_2009	
Ethyl-t-butylether (ETBE)	EPA 524.3_1.0_2009	
Hexachlorobutadiene	EPA 524.3_1.0_2009	
Hexachloroethane	EPA 524.3_1.0_2009	
Iodomethane (Methyl iodide)	EPA 524.3_1.0_2009	
Isopropylbenzene	EPA 524.3_1.0_2009	
Methyl acetate	EPA 524.3_1.0_2009	
Methyl bromide (Bromomethane)	EPA 524.3_1.0_2009	
Methyl chloride (Chloromethane)	EPA 524.3_1.0_2009	
Methyl tert-butyl ether (MTBE)	EPA 524.3_1.0_2009	
Methylene chloride (Dichloromethane)	EPA 524.3_1.0_2009	
m-Xylene	EPA 524.3_1.0_2009	
Naphthalene	EPA 524.3_1.0_2009	
n-Butylbenzene	EPA 524.3_1.0_2009	
n-Propylbenzene	EPA 524.3_1.0_2009	
o-Xylene	EPA 524.3_1.0_2009	
Pentachloroethane	EPA 524.3_1.0_2009	
p-Xylene	EPA 524.3_1.0_2009	
sec-Butylbenzene	EPA 524.3_1.0_2009	
Styrene	EPA 524.3_1.0_2009	
tert-Amyl ethyl ether (TAEE)	EPA 524.3_1.0_2009	
tert-amylmethylether (TAME)	EPA 524.3_1.0_2009	
tert-Butylbenzene	EPA 524.3_1.0_2009	
Tetrachloroethylene (Perchloroethylene)	EPA 524.3_1.0_2009	

Matrix/Analyte	Method	Notes
Tetrahydrofuran (THF)	EPA 524.3_1.0_2009	
Toluene	EPA 524.3_1.0_2009	
Total Trihalomethanes	EPA 524.3_1.0_2009	
trans-1,3-Dichloropropylene	EPA 524.3_1.0_2009	
Trichloroethene (Trichloroethylene)	EPA 524.3_1.0_2009	
Trichlorofluoromethane (Freon 11)	EPA 524.3_1.0_2009	
Vinyl chloride	EPA 524.3_1.0_2009	
Xylene (total)	EPA 524.3_1.0_2009	
Non-Potable Water		
Specific Conductance	EPA 120.1_1982	1
Solids, Total Volatile	EPA 160.4_1971	1
n-Hexane Extractable Material (O&G)	EPA 1664B -10 (HEM)	1
Turbidity	EPA 180.1_2_1993	1
Bromide	EPA 300.0_2.1_1993	1
Chloride	EPA 300.0_2.1_1993	1
Fluoride	EPA 300.0_2.1_1993	1
Nitrate	EPA 300.0_2.1_1993	1
Nitrite	EPA 300.0_2.1_1993	1
Orthophosphate	EPA 300.0_2.1_1993	1
Sulfate	EPA 300.0_2.1_1993	1
Nitrogen, Total Kjeldahl	EPA 351.2_2_1993	1
Nitrate	EPA 353.2_2_1993	1
Nitrate + Nitrite	EPA 353.2_2_1993	1
Nitrite	EPA 353.2_2_1993	1
Sulfate	EPA 375.2_2_1993	1
Chemical Oxygen Demand (COD)	EPA 410.4_2_1993	1
Phenolics, Total	EPA 420.1_1978	1
Dissolved Oxygen	In-Situ 1002-8-2009	
Biochemical Oxygen Demand (BOD)	In-Situ 1003-8-2009	
Carbonaceous BOD (CBOD)	In-Situ 1004-8-2009	
Color	SM 2120 B-01	1
Turbidity	SM 2130 B-01	1
Alkalinity	SM 2320 B-97	1
Langlier index	SM 2330 B-00	
Hardness (calc.)	SM 2340 B-97	1

Matrix/Analyte	Method	Notes
Specific Conductance	SM 2510 B-97	1
Salinity	SM 2520 B-93	1
Solids, Total	SM 2540 B-97	1
Solids, Total Dissolved	SM 2540 C-97	1
Solids, Total Suspended	SM 2540 D-97	1
Solids, Total, Fixed and Volatile	SM 2540 E-97	1
Solids, Settleable	SM 2540 F-97	1
Oxidation-Reduction Potential (ORP)	SM 2580 B-97	1
Chromium, Hexavalent	SM 3500-Cr B-09	1
Iron, Ferrous	SM 3500-Fe B-97	1
Bromide	SM 4110 B-00	1
Chloride	SM 4110 B-00	1
Fluoride	SM 4110 B-00	1
Nitrate	SM 4110 B-00	1
Nitrite	SM 4110 B-00	1
Orthophosphate	SM 4110 B-00	1
Sulfate	SM 4110 B-00	1
Chloride	SM 4500-Cl^- G-97	10
Cyanide, Total	SM 4500-CN^- E-99	1
Cyanides, Amenable to Chlorination	SM 4500-CN^- G-99	1
Cyanide, Weak Acid Dissociable	SM 4500-CN^- I-97	1
Fluoride	SM 4500-F^- C-97	1
pH	SM 4500-H+ B-00	1,8
Ammonia	SM 4500-NH3 D-97	1
Ammonia	SM 4500-NH3 H-97	1
Nitrogen, Total Kjeldahl	SM 4500-Norg D-97	1
Dissolved Oxygen	SM 4500-O C-01	
Orthophosphate	SM 4500-P E-99	1
Phosphorus, total	SM 4500-P E-99	1
Sulfide	SM 4500-$S2^-$ D-00	1
Sulfide	SM 4500-$S2^-$ F-00	1
Sulfite	SM 4500-$SO3^-$ B-00	1
Sulfate	SM 4500-$SO4^-$ G-97	1
Biochemical Oxygen Demand (BOD)	SM 5210 B-01	1
Carbonaceous BOD (CBOD)	SM 5210 B-01	1
Chemical Oxygen Demand (COD)	SM 5220 D-97	1

Matrix/Analyte	Method	Notes
Dissolved Organic Carbon	SM 5310 B-00	1
Total Organic Carbon	SM 5310 B-00	1
non-Polar Extractable Material (TPH)	SM 5520 F-01	1
Phenolics, Total	SM 5530 D-05	1
Aluminum	EPA 200.7_4.4_1994	1
Antimony	EPA 200.7_4.4_1994	1
Arsenic	EPA 200.7_4.4_1994	1
Barium	EPA 200.7_4.4_1994	1
Beryllium	EPA 200.7_4.4_1994	1
Boron	EPA 200.7_4.4_1994	1
Cadmium	EPA 200.7_4.4_1994	1
Calcium	EPA 200.7_4.4_1994	1
Chromium	EPA 200.7_4.4_1994	1
Cobalt	EPA 200.7_4.4_1994	1
Copper	EPA 200.7_4.4_1994	1
Iron	EPA 200.7_4.4_1994	1
Lead	EPA 200.7_4.4_1994	1
Magnesium	EPA 200.7_4.4_1994	1
Manganese	EPA 200.7_4.4_1994	1
Molybdenum	EPA 200.7_4.4_1994	1
Nickel	EPA 200.7_4.4_1994	1
Potassium	EPA 200.7_4.4_1994	1
Selenium	EPA 200.7_4.4_1994	1
Silicon	EPA 200.7_4.4_1994	1
Silver	EPA 200.7_4.4_1994	1
Sodium	EPA 200.7_4.4_1994	1
Strontium	EPA 200.7_4.4_1994	1
Thallium	EPA 200.7_4.4_1994	1
Tin	EPA 200.7_4.4_1994	1
Titanium	EPA 200.7_4.4_1994	1
Vanadium	EPA 200.7_4.4_1994	1
Zinc	EPA 200.7_4.4_1994	1
Aluminum	EPA 200.8_5.4_1994	1
Antimony	EPA 200.8_5.4_1994	1
Arsenic	EPA 200.8_5.4_1994	1
Barium	EPA 200.8_5.4_1994	1

Matrix/Analyte	Method	Notes
Beryllium	EPA 200.8_5.4_1994	1
Cadmium	EPA 200.8_5.4_1994	1
Calcium	EPA 200.8_5.4_1994	1
Chromium	EPA 200.8_5.4_1994	1
Cobalt	EPA 200.8_5.4_1994	1
Copper	EPA 200.8_5.4_1994	1
Iron	EPA 200.8_5.4_1994	1
Lead	EPA 200.8_5.4_1994	1
Magnesium	EPA 200.8_5.4_1994	1
Manganese	EPA 200.8_5.4_1994	1
Molybdenum	EPA 200.8_5.4_1994	1
Nickel	EPA 200.8_5.4_1994	1
Potassium	EPA 200.8_5.4_1994	1
Selenium	EPA 200.8_5.4_1994	1
Silver	EPA 200.8_5.4_1994	1
Sodium	EPA 200.8_5.4_1994	1
Thallium	EPA 200.8_5.4_1994	1
Vanadium	EPA 200.8_5.4_1994	1
Zinc	EPA 200.8_5.4_1994	1
Mercury	EPA 245.1_3_1994	1
VOA & Semi-VOA Compounds	ARI SOP 427S	4
4,4'-DDD	EPA 608	
4,4'-DDE	EPA 608	
4,4'-DDT	EPA 608	
Alachlor	EPA 608	
Aldrin	EPA 608	
alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 608	
alpha-Chlordane	EPA 608	
Aroclor-1016 (PCB-1016)	EPA 608	
Aroclor-1221 (PCB-1221)	EPA 608	
Aroclor-1232 (PCB-1232)	EPA 608	
Aroclor-1242 (PCB-1242)	EPA 608	
Aroclor-1248 (PCB-1248)	EPA 608	
Aroclor-1254 (PCB-1254)	EPA 608	
Aroclor-1260 (PCB-1260)	EPA 608	
Aroclor-1262 (PCB-1262)	EPA 608	

Matrix/Analyte	Method	Notes
Aroclor-1268 (PCB-1268)	EPA 608	
Atrazine	EPA 608	
beta-BHC (beta-Hexachlorocyclohexane)	EPA 608	
Chlordane (tech.)	EPA 608	
delta-BHC	EPA 608	
Dieldrin	EPA 608	
Endosulfan I	EPA 608	
Endosulfan II	EPA 608	
Endosulfan sulfate	EPA 608	
Endrin	EPA 608	
Endrin aldehyde	EPA 608	
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	EPA 608	
gamma-Chlordane	EPA 608	
Heptachlor	EPA 608	
Heptachlor epoxide	EPA 608	
Hexachlorobenzene	EPA 608	
Hexachlorocyclopentadiene	EPA 608	
Methoxychlor	EPA 608	
Metribuzin	EPA 608	
Propachlor (Ramrod)	EPA 608	
Simazine	EPA 608	
Toxaphene (Chlorinated camphene)	EPA 608	
Trifluralin (Treflan)	EPA 608	
Acetylene	EPA RSK-175	1
Ethane	EPA RSK-175	1
Ethene	EPA RSK-175	1
Methane	EPA RSK-175	1
n-Propane	EPA RSK-175	1
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	EPA 1613_1994	1
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	EPA 1613_1994	1
1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7	EPA 1613_1994	1
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4	EPA 1613_1994	1
1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8	EPA 1613_1994	1
1,2,3,4,7,8-Hxcdd	EPA 1613_1994	1
1,2,3,4,7,8-Hxcdf	EPA 1613_1994	1
1,2,3,6,7,8-Hxcdd	EPA 1613_1994	1

Matrix/Analyte	Method	Notes
1,2,3,6,7,8-Hxcdf	EPA 1613_1994	1
1,2,3,7,8,9-Hpcdf	EPA 1613_1994	1
1,2,3,7,8,9-Hxcdd	EPA 1613_1994	1
1,2,3,7,8,9-Hxcdf	EPA 1613_1994	1
1,2,3,7,8-Pecdd	EPA 1613_1994	1
1,2,3,7,8-Pecdf	EPA 1613_1994	1
2,3,4,6,7,8-Hxcdf	EPA 1613_1994	1
2,3,4,7,8-Pecdf	EPA 1613_1994	1
2,3,7,8-TCDD	EPA 1613_1994	1
2,3,7,8-TCDF	EPA 1613_1994	1
Hpcdd, total	EPA 1613_1994	1
Hpcdf, total	EPA 1613_1994	1
Hxcdd, total	EPA 1613_1994	1
Hxcdf, total	EPA 1613_1994	1
Pecdd, total	EPA 1613_1994	1
Pecdf, total	EPA 1613_1994	1
TCDD, total	EPA 1613_1994	1
TCDF, total	EPA 1613_1994	1
1,1,1,2-Tetrachloroethane	EPA 624	
1,1,1-Trichloroethane	EPA 624	
1,1,2,2-Tetrachloroethane	EPA 624	
1,1,2-Trichloroethane	EPA 624	
1,1-Dichloroethane	EPA 624	
1,1-Dichloroethylene	EPA 624	
1,2,3-Trichlorobenzene	EPA 624	
1,2,4-Trichlorobenzene	EPA 624	
1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA 624	
1,2-Dichlorobenzene	EPA 624	
1,2-Dichloroethane (Ethylene dichloride)	EPA 624	
1,2-Dichloropropane	EPA 624	
1,3-Dichlorobenzene	EPA 624	
1,4-Dichlorobenzene	EPA 624	
2-Butanone (Methyl ethyl ketone, MEK)	EPA 624	
2-Chloro-1,3-butadiene (Chloroprene)	EPA 624	
2-Chloroethyl vinyl ether	EPA 624	
2-Picoline (2-Methylpyridine)	EPA 624	

Matrix/Analyte	Method	Notes
4-Isopropyltoluene (p-Cymene)	EPA 624	
Acetone	EPA 624	
Acetonitrile	EPA 624	
Acrolein (Propenal)	EPA 624	
Acrylonitrile	EPA 624	
Benzene	EPA 624	
Bromodichloromethane	EPA 624	
Bromoform	EPA 624	
Carbon tetrachloride	EPA 624	
Chlorobenzene	EPA 624	
Chlorodibromomethane	EPA 624	
Chloroethane (Ethyl chloride)	EPA 624	
Chloroform	EPA 624	
cis-1,3-Dichloropropene	EPA 624	
Dibromochloropropane	EPA 624	
Dichlorodifluoromethane (Freon-12)	EPA 624	
Dichloromethane (DCM, Methylene chloride)	EPA 624	
Diethyl ether	EPA 624	
Epichlorohydrin (1-Chloro-2,3-epoxypropane)	EPA 624	
Ethylbenzene	EPA 624	
Methyl bromide (Bromomethane)	EPA 624	
Methyl chloride (Chloromethane)	EPA 624	
Methyl tert-butyl ether (MTBE)	EPA 624	
Methylene chloride (Dichloromethane)	EPA 624	
Naphthalene	EPA 624	
Nitrobenzene	EPA 624	
p-Dioxane	EPA 624	
Styrene	EPA 624	
Tetrachloroethylene (Perchloroethylene)	EPA 624	
Toluene	EPA 624	
trans-1,2-Dichloroethylene	EPA 624	
trans-1,3-Dichloropropylene	EPA 624	
Trichloroethene (Trichloroethylene)	EPA 624	
Trichlorofluoromethane (Freon 11)	EPA 624	
Vinyl chloride	EPA 624	
1,2,4-Trichlorobenzene	EPA 625	

Matrix/Analyte	Method	Notes
1,2-Dichlorobenzene	EPA 625	
1,2-Diphenylhydrazine	EPA 625	
1,3-Dichlorobenzene	EPA 625	
1,4-Dichlorobenzene	EPA 625	
1,4-Naphthoquinone	EPA 625	
1-Chloronaphthalene	EPA 625	
1-Naphthylamine	EPA 625	
2,3,6-Trichlorophenol (4C)	EPA 625	
2,4,5-Trichlorophenol	EPA 625	
2,4,6-Trichlorophenol	EPA 625	
2,4-Dichlorophenol	EPA 625	
2,4-Dimethylphenol	EPA 625	
2,4-Dinitrophenol	EPA 625	
2,4-Dinitrotoluene (2,4-DNT)	EPA 625	
2,6-Dinitrotoluene (2,6-DNT)	EPA 625	
2-Chloronaphthalene	EPA 625	
2-Chlorophenol	EPA 625	
2-Naphthylamine	EPA 625	
2-Nitrophenol	EPA 625	
3,3'-Dichlorobenzidine	EPA 625	
4,4'-DDD	EPA 625	
4,4'-DDE	EPA 625	
4,4'-DDT	EPA 625	
4,6-Dinitro-2-methylphenol	EPA 625	
4-Bromophenyl phenyl ether (BDE-3)	EPA 625	
4-Chloro-3-methylphenol	EPA 625	
4-Chlorophenol	EPA 625	
4-Chlorophenyl phenylether	EPA 625	
4-Nitrophenol	EPA 625	
Acenaphthene	EPA 625	
Acenaphthylene	EPA 625	
Aldrin	EPA 625	
alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 625	
alpha-Terpineol	EPA 625	
Anthracene	EPA 625	
Atrazine	EPA 625	

Matrix/Analyte	Method	Notes
Benzidine	EPA 625	
Benzo(a)anthracene	EPA 625	
Benzo(a)pyrene	EPA 625	
Benzo(g,h,i)perylene	EPA 625	
Benzo(k)fluoranthene	EPA 625	
Benzo[b]fluoranthene	EPA 625	
Benzoic acid	EPA 625	
beta-BHC (beta-Hexachlorocyclohexane)	EPA 625	
Biphenyl	EPA 625	
bis(2-Chloroethoxy)methane	EPA 625	
bis(2-Chloroethyl) ether	EPA 625	
bis(2-Chloroisopropyl) ether	EPA 625	
bis(2-Ethylhexyl) phthalate (DEHP)	EPA 625	
Butyl benzyl phthalate	EPA 625	
Carbazole	EPA 625	
Chlordane (tech.)	EPA 625	
Chrysene	EPA 625	
delta-BHC	EPA 625	
Di(2-ethylhexyl)adipate	EPA 625	
Dibenz(a,h) anthracene	EPA 625	
Dibenzofuran	EPA 625	
Dieldrin	EPA 625	
Diethyl phthalate	EPA 625	
Dimethyl phthalate	EPA 625	
Di-n-butyl phthalate	EPA 625	
Di-n-octyl phthalate	EPA 625	
Endosulfan I	EPA 625	
Endosulfan II	EPA 625	
Endosulfan sulfate	EPA 625	
Endrin	EPA 625	
Fluoranthene	EPA 625	
Fluorene	EPA 625	
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	EPA 625	
Heptachlor	EPA 625	
Heptachlor epoxide	EPA 625	
Hexachlorobenzene	EPA 625	

Matrix/Analyte	Method	Notes
Hexachlorobutadiene	EPA 625	
Hexachlorocyclopentadiene	EPA 625	
Hexachloroethane	EPA 625	
Hexachloropropene	EPA 625	
Indeno(1,2,3-cd) pyrene	EPA 625	
Isophorone	EPA 625	
Methoxychlor	EPA 625	
Naphthalene	EPA 625	
n-Decane	EPA 625	
n-Docosane	EPA 625	
n-Dodecane	EPA 625	
n-Eicosane	EPA 625	
n-Hexadecane	EPA 625	
Nitrobenzene	EPA 625	
N-Nitrosodiethylamine	EPA 625	
N-Nitrosodimethylamine	EPA 625	
N-Nitroso-di-n-butylamine	EPA 625	
N-Nitroso-di-n-propylamine	EPA 625	
N-Nitrosodiphenylamine	EPA 625	
n-Octadecane	EPA 625	
n-Tetradecane	EPA 625	
Pentachloroethane	EPA 625	
Pentachlorophenol	EPA 625	
Phenanthrene	EPA 625	
Phenol	EPA 625	
Pyrene	EPA 625	
Pyridine	EPA 625	
Toxaphene (Chlorinated camphene)	EPA 625	
Total coliforms-count	SM 9222 B (M-endo)-97	
Fecal coliform-count	SM 9222 D (m-FC)-97	
Solid and Chemical Materials		
n-Hexane Extractable Material (O&G)	EPA 1664B -10 (HEM)	
Nitrogen, Total Kjeldahl	EPA 351.2_2_1993	1
Nitrate + Nitrite	EPA 353.2_2_1993	1
Chromium, Hexavalent	EPA 7196A_1_1992	1

Matrix/Analyte	Method	Notes
Cyanide, Total	EPA 9010C_2002	1
Cyanides, Amenable to Chlorination	EPA 9010C_2002	1
Cyanide, Total	EPA 9014_1996	1
Sulfide	EPA 9030B_2_1996	1
Sulfide	EPA 9034_1996	1
Sulfate	EPA 9036_0_1986	1
pH	EPA 9040C_2002	1
pH	EPA 9045D_2002	1
Specific Conductance	EPA 9050A_1_1996	1
Bromide	EPA 9056A_(11/00)	1
Chloride	EPA 9056A_(11/00)	1
Fluoride	EPA 9056A_(11/00)	1
Nitrate	EPA 9056A_(11/00)	1
Nitrite	EPA 9056A_(11/00)	1
Orthophosphate	EPA 9056A_(11/00)	1
Sulfate	EPA 9056A_(11/00)	1
Dissolved Organic Carbon	EPA 9060A_1_2004	
Total Organic Carbon	EPA 9060A_1_2004	1
Phenolics, Total	EPA 9065_1986	1
n-Hexane Extractable Material (O&G)	EPA 9071 B_2_1999	1
Fluoride	EPA 9214_1996	1
Chloride	EPA 9251_(9/86)	1
Biochemical Oxygen Demand (BOD)	In-Situ 1003-8-2009	
Total Organic Carbon	PSEP 1986 Combust/Grav	
Alkalinity	SM 2320 B-97	
Solids, Total, Fixed and Volatile	SM 2540 G-97	10
Oxidation-Reduction Potential (ORP)	SM 2580 B-97	1
Ammonia	SM 4500-NH3 H-97	1
Nitrate	SM 4500-NO3¯ I-00	1
Nitrate + Nitrite	SM 4500-NO3¯ I-00	1
Nitrite	SM 4500-NO3¯ I-00	1
Nitrogen, Total Kjeldahl	SM 4500-Norg D-97	1
Phosphorus, total	SM 4500-P E-99	1
Sulfide	SM 4500-S2¯ D-00	1
Sulfate	SM 4500-SO4¯ G-97	1

Matrix/Analyte	Method	Notes
Biochemical Oxygen Demand (BOD)	SM 5210 B-01	
Chemical Oxygen Demand (COD)	SM 5220 D-97	
n-Hexane Extractable Material (O&G)	SM 5520 G-05	
Mercury	EPA 245.5_1974	1
Aluminum	EPA 6010C_(2/07)	1
Antimony	EPA 6010C_(2/07)	1
Arsenic	EPA 6010C_(2/07)	1
Barium	EPA 6010C_(2/07)	1
Beryllium	EPA 6010C_(2/07)	1
Boron	EPA 6010C_(2/07)	1
Cadmium	EPA 6010C_(2/07)	1
Calcium	EPA 6010C_(2/07)	1
Chromium	EPA 6010C_(2/07)	1
Cobalt	EPA 6010C_(2/07)	1
Copper	EPA 6010C_(2/07)	1
Iron	EPA 6010C_(2/07)	1
Lead	EPA 6010C_(2/07)	1
Magnesium	EPA 6010C_(2/07)	1
Manganese	EPA 6010C_(2/07)	1
Molybdenum	EPA 6010C_(2/07)	1
Nickel	EPA 6010C_(2/07)	1
Potassium	EPA 6010C_(2/07)	1
Selenium	EPA 6010C_(2/07)	1
Silicon	EPA 6010C_(2/07)	1
Silver	EPA 6010C_(2/07)	1
Sodium	EPA 6010C_(2/07)	1
Strontium	EPA 6010C_(2/07)	1
Thallium	EPA 6010C_(2/07)	1
Tin	EPA 6010C_(2/07)	1
Titanium	EPA 6010C_(2/07)	1
Vanadium	EPA 6010C_(2/07)	1
Zinc	EPA 6010C_(2/07)	1
Aluminum	EPA 6020A_(2/07)	1
Antimony	EPA 6020A_(2/07)	1
Arsenic	EPA 6020A_(2/07)	1
Barium	EPA 6020A_(2/07)	1

Matrix/Analyte	Method	Notes
Beryllium	EPA 6020A_(2/07)	1
Cadmium	EPA 6020A_(2/07)	1
Calcium	EPA 6020A_(2/07)	1
Chromium	EPA 6020A_(2/07)	1
Cobalt	EPA 6020A_(2/07)	1
Copper	EPA 6020A_(2/07)	1
Iron	EPA 6020A_(2/07)	1
Lead	EPA 6020A_(2/07)	1
Magnesium	EPA 6020A_(2/07)	1
Manganese	EPA 6020A_(2/07)	1
Molybdenum	EPA 6020A_(2/07)	1
Nickel	EPA 6020A_(2/07)	1
Potassium	EPA 6020A_(2/07)	1
Selenium	EPA 6020A_(2/07)	1
Silver	EPA 6020A_(2/07)	1
Sodium	EPA 6020A_(2/07)	1
Thallium	EPA 6020A_(2/07)	1
Vanadium	EPA 6020A_(2/07)	1
Zinc	EPA 6020A_(2/07)	1
Mercury	EPA 7470A_1_1994	1
Mercury	EPA 7471B_(1/98)	1
VOA & Semi-VOA Compounds	ARI SOP 427S	4
Diesel range organics (DRO)	EPA 8015C_(11/00)	10
Gasoline range organics (GRO)	EPA 8015C_(11/00)	
Benzene	EPA 8021B_2_(12/96)	1
Ethylbenzene	EPA 8021B_2_(12/96)	1
m+p-xylene	EPA 8021B_2_(12/96)	1
Methyl tert-butyl ether (MTBE)	EPA 8021B_2_(12/96)	1
o-Xylene	EPA 8021B_2_(12/96)	1
Toluene	EPA 8021B_2_(12/96)	1
Xylene (total)	EPA 8021B_2_(12/96)	1
2,3,4,5-Tetrachlorophenol	EPA 8041A_(11/00)	5
2,3,4-Trichlorophenol	EPA 8041A_(11/00)	5
2,3,5,6-Tetrachlorophenol	EPA 8041A_(11/00)	5
2,3,6-Trichlorophenol	EPA 8041A_(11/00)	5
2,4,5-Trichlorophenol	EPA 8041A_(11/00)	5

Matrix/Analyte	Method	Notes
2,4,6-Trichlorophenol	EPA 8041A_(11/00)	5
2,4-Dichlorophenol	EPA 8041A_(11/00)	5
2,4-Dimethylphenol	EPA 8041A_(11/00)	5
2,4-Dinitrophenol	EPA 8041A_(11/00)	5
2,5-Dinitrophenol	EPA 8041A_(11/00)	5
2,6-Dichlorophenol	EPA 8041A_(11/00)	5
2-Chlorophenol	EPA 8041A_(11/00)	5
2-Cyclohexyl-4,6-dinitrophenol	EPA 8041A_(11/00)	5
Pentachlorophenol	EPA 8041A_(11/00)	5
2,4'-DDD	EPA 8081B_(2/07)	1,7
2,4'-DDE	EPA 8081B_(2/07)	1,7
2,4'-DDT	EPA 8081B_(2/07)	1,7
4,4'-DDD	EPA 8081B_(2/07)	1,7
4,4'-DDE	EPA 8081B_(2/07)	1,7
4,4'-DDT	EPA 8081B_(2/07)	1,7
Alachlor	EPA 8081B_(2/07)	1,7
Aldrin	EPA 8081B_(2/07)	1,7
alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 8081B_(2/07)	1,7
alpha-Chlordane	EPA 8081B_(2/07)	1,7
beta-BHC (beta-Hexachlorocyclohexane)	EPA 8081B_(2/07)	1,7
Chlordane (tech.)	EPA 8081B_(2/07)	1,7
Chlorothalonil	EPA 8081B_(2/07)	1,7
cis-Nonachlor	EPA 8081B_(2/07)	1,7
Dacthal (DCPA)	EPA 8081B_(2/07)	1,7
delta-BHC	EPA 8081B_(2/07)	1,7
Dieldrin	EPA 8081B_(2/07)	1,7
Endosulfan I	EPA 8081B_(2/07)	1,7
Endosulfan II	EPA 8081B_(2/07)	1,7
Endosulfan sulfate	EPA 8081B_(2/07)	1,7
Endrin	EPA 8081B_(2/07)	1,7
Endrin aldehyde	EPA 8081B_(2/07)	1,7
Endrin ketone	EPA 8081B_(2/07)	1,7
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	EPA 8081B_(2/07)	1,7
gamma-Chlordane	EPA 8081B_(2/07)	1,7
Heptachlor	EPA 8081B_(2/07)	1,7
Heptachlor epoxide	EPA 8081B_(2/07)	1,7

Matrix/Analyte	Method	Notes
Hexachlorobenzene	EPA 8081B_(2/07)	1,7
Hexachlorobutadiene	EPA 8081B_(2/07)	1,7
Hexachlorocyclopentadiene	EPA 8081B_(2/07)	1,7
Hexachloroethane	EPA 8081B_(2/07)	1,7
Isodrin	EPA 8081B_(2/07)	1,7
Methoxychlor	EPA 8081B_(2/07)	1,7
Mirex	EPA 8081B_(2/07)	1,7
Oxychlordane	EPA 8081B_(2/07)	1,7
Toxaphene (Chlorinated camphene)	EPA 8081B_(2/07)	1,7
trans-Nonachlor	EPA 8081B_(2/07)	1,7
Trifluralin (Treflan)	EPA 8081B_(2/07)	1,7
2,2',3,3',4,4',5,5'-Octachlorobiphenyl (BZ-194)	EPA 8082A_(2/07)	1
2,2',3,3',4,4',5,6-Octachlorobiphenyl (BZ-195)	EPA 8082A_(2/07)	1
2,2',3,3',4,4',5-Heptachlorobiphenyl (BZ-170)	EPA 8082A_(2/07)	1
2,2',3,3',4,4'-Hexachlorobiphenyl (BZ-128)	EPA 8082A_(2/07)	1
2,2',3,3',4,5',6,6'-Octachlorobiphenyl (BZ-201)	EPA 8082A_(2/07)	1
2,2',3,3',4,5,6'-Heptachlorobiphenyl (BZ-174)	EPA 8082A_(2/07)	1
2,2',3,3',4,5',6'-Heptachlorobiphenyl (BZ-177)	EPA 8082A_(2/07)	1
2,2',3,3',4,6'-Hexachlorobiphenyl (BZ-132)	EPA 8082A_(2/07)	1
2,2',3,4,4',5,5',6-Octachlorobiphenyl (BZ-203)	EPA 8082A_(2/07)	1
2,2',3,4,4',5,5'-Heptachlorobiphenyl (BZ-180)	EPA 8082A_(2/07)	1
2,2',3,4,4',5',6-Heptabromodiphenylether (BDE-183)	EPA 8082A_(2/07)	1
2,2',3,4,4',5',6-Heptachlorobiphenyl (BZ-183)	EPA 8082A_(2/07)	1
2,2',3,4,4',5'-Hexabromodiphenylether (BDE-138)	EPA 8082A_(2/07)	1
2,2',3,4,4',5'-Hexachlorobiphenyl (BZ-138)	EPA 8082A_(2/07)	1
2,2',3,4,4'-Pentabromodiphenylether (BDE-85)	EPA 8082A_(2/07)	1
2,2',3,4',5,5',6-Heptachlorobiphenyl (BZ-187)	EPA 8082A_(2/07)	1
2,2',3,4,5,5'-Hexachlorobiphenyl (BZ-141)	EPA 8082A_(2/07)	1
2,2',3,4',5',6-Hexachlorobiphenyl (BZ-149)	EPA 8082A_(2/07)	1
2,2',3,4,5'-Pentachlorobiphenyl (BZ-87)	EPA 8082A_(2/07)	1
2,2',3,4',5'-Pentachlorobiphenyl (BZ-97)	EPA 8082A_(2/07)	1
2,2',3,5,5',6-Hexachlorobiphenyl (BZ-151)	EPA 8082A_(2/07)	1
2,2',3,5',6-Pentachlorobiphenyl (BZ-95)	EPA 8082A_(2/07)	1
2,2',3,5'-Tetrachlorobiphenyl (BZ-44)	EPA 8082A_(2/07)	1
2,2',4,4',5,5'-Hexabromodiphenyl ether (BDE-153)	EPA 8082A_(2/07)	1
2,2',4,4',5,5'-Hexachlorobiphenyl (BZ-153)	EPA 8082A_(2/07)	1

Matrix/Analyte	Method	Notes
2,2',4,4',5',6-Hexabromodiphenylether (BDE-154)	EPA 8082A_(2/07)	1
2,2',4,4',5-Pentabromodiphenyl ether (BDE-99)	EPA 8082A_(2/07)	1
2,2',4,4',5-Pentachlorobiphenyl (BZ-99)	EPA 8082A_(2/07)	1
2,2',4,4',6-Pentabromodiphenyl ether (BDE-100)	EPA 8082A_(2/07)	1
2,2',4,4'-Tetrabromodiphenyl ether (BDE-47)	EPA 8082A_(2/07)	1
2,2',4,5,5'-Pentachlorobiphenyl (BZ-101)	EPA 8082A_(2/07)	1
2,2',4,5'-Tetrachlorobiphenyl (BZ-49)	EPA 8082A_(2/07)	1
2,2',4-Tribromodiphenylether (BDE-17)	EPA 8082A_(2/07)	1
2,2',5,5'-Tetrachlorobiphenyl (BZ-52)	EPA 8082A_(2/07)	1
2,2',5-Trichlorobiphenyl (BZ-18)	EPA 8082A_(2/07)	1
2,3,3',4,4',5-Hexachlorobiphenyl (BZ-156)	EPA 8082A_(2/07)	1
2,3,3',4,4',6-Hexachlorobiphenyl (BZ-158)	EPA 8082A_(2/07)	1
2,3,3',4,4'-Pentachlorobiphenyl (BZ-105)	EPA 8082A_(2/07)	1
2,3,3',4',6-Pentachlorobiphenyl (BZ-110)	EPA 8082A_(2/07)	1
2,3,3',4'-Tetrachlorobiphenyl (BZ-56)	EPA 8082A_(2/07)	1
2,3',4,4',5-Pentachlorobiphenyl (BZ-118)	EPA 8082A_(2/07)	1
2,3',4,4'-Tetrabromodiphenylether (BDE-66)	EPA 8082A_(2/07)	1
2,3,4,4'-Tetrachlorobiphenyl (BZ-60)	EPA 8082A_(2/07)	1
2,3',4,4'-Tetrachlorobiphenyl (BZ-66)	EPA 8082A_(2/07)	1
2,3',4',5-Tetrachlorobiphenyl (BZ-70)	EPA 8082A_(2/07)	1
2,3',4',6-Tetrabromodiphenylether (BDE-71)	EPA 8082A_(2/07)	1
2,3',4'-Trichlorobiphenyl (BZ-33)	EPA 8082A_(2/07)	1
2,4,4',5-Tetrachlorobiphenyl (BZ-74)	EPA 8082A_(2/07)	1
2,4,4'-Tribromodiphenylether (BDE-28)	EPA 8082A_(2/07)	1
2,4,4'-Trichlorobiphenyl (BZ-28)	EPA 8082A_(2/07)	1
2,4',5-Trichlorobiphenyl (BZ-31)	EPA 8082A_(2/07)	1
2,4'-Dichlorobiphenyl (BZ-8)	EPA 8082A_(2/07)	1
Aroclor-1016 (PCB-1016)	EPA 8082A_(2/07)	1,6
Aroclor-1221 (PCB-1221)	EPA 8082A_(2/07)	1,6
Aroclor-1232 (PCB-1232)	EPA 8082A_(2/07)	1,6
Aroclor-1242 (PCB-1242)	EPA 8082A_(2/07)	1,6
Aroclor-1248 (PCB-1248)	EPA 8082A_(2/07)	1,6
Aroclor-1254 (PCB-1254)	EPA 8082A_(2/07)	1,6
Aroclor-1260 (PCB-1260)	EPA 8082A_(2/07)	1,6
Aroclor-1262 (PCB-1262)	EPA 8082A_(2/07)	1,6
Aroclor-1268 (PCB-1268)	EPA 8082A_(2/07)	1,6

Matrix/Analyte	Method	Notes
2,4,5-T	EPA 8151A_(1/98)	1,5
2,4-D	EPA 8151A_(1/98)	1,5
2,4-DB	EPA 8151A_(1/98)	1,5
Dacthal (DCPA)	EPA 8151A_(1/98)	1,5
Dalapon	EPA 8151A_(1/98)	1,5
Dicamba	EPA 8151A_(1/98)	1,5
Dichloroprop (Dichlorprop)	EPA 8151A_(1/98)	1,5
Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)	EPA 8151A_(1/98)	1,5
MCPA	EPA 8151A_(1/98)	1,5
MCPP	EPA 8151A_(1/98)	1,5
Pentachlorophenol	EPA 8151A_(1/98)	1,5
Picloram	EPA 8151A_(1/98)	1,5
Silvex (2,4,5-TP)	EPA 8151A_(1/98)	1,5
C8-C10 Aliphatic EPH	WDOE EPH_(1997)	1,3
C8-C10 Aromatic EPH	WDOE EPH_(1997)	1,3
>C10-C12 Aliphatic EPH	WDOE EPH_(1997)	1,3
>C10-C12 Aromatic EPH	WDOE EPH_(1997)	1,3
>C12-C16 Aliphatic EPH	WDOE EPH_(1997)	1,3
>C12-C16 Aromatic EPH	WDOE EPH_(1997)	1,3
>C16-C21 Aliphatic EPH	WDOE EPH_(1997)	1,3
>C16-C21 Aromatic EPH	WDOE EPH_(1997)	1,3
>C21-C34 Alpihatic EPH	WDOE EPH_(1997)	1,3
>C21-C34 Aromatic EPH	WDOE EPH_(1997)	1,3
Diesel range organics (DRO)	WDOE NWTPH-Dx_(1997)	1,3
Gasoline range organics (GRO)	WDOE NWTPH-Gx_(1997)	1,3,9
C8-C10 Aromatic VPH	WDOE VPH_(1997)	1,3
C5-C6 Aliphatic VPH	WDOE VPH_(1997)	1,3
>C10-C12 Aliphatic VPH	WDOE VPH_(1997)	1,3
>C10-C12 Aromatic VPH	WDOE VPH_(1997)	1,3
>C12-C13 Aromatic VPH	WDOE VPH_(1997)	1,3
>C6-C8 Aliphatic VPH	WDOE VPH_(1997)	1,3
>C8-C10 Aliphatic VPH	WDOE VPH_(1997)	1,3
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	EPA 1613_1994	1
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	EPA 1613_1994	1

Matrix/Analyte	Method	Notes
1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7	EPA 1613_1994	1
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4	EPA 1613_1994	1
1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8	EPA 1613_1994	1
1,2,3,4,7,8-Hxcdd	EPA 1613_1994	1
1,2,3,4,7,8-Hxcdf	EPA 1613_1994	1
1,2,3,6,7,8-Hxcdd	EPA 1613_1994	1
1,2,3,6,7,8-Hxcdf	EPA 1613_1994	1
1,2,3,7,8,9-Hpcdf	EPA 1613_1994	1
1,2,3,7,8,9-Hxcdd	EPA 1613_1994	1
1,2,3,7,8,9-Hxcdf	EPA 1613_1994	1
1,2,3,7,8-Pecdd	EPA 1613_1994	1
1,2,3,7,8-Pecdf	EPA 1613_1994	1
2,3,4,6,7,8-Hxcdf	EPA 1613_1994	1
2,3,4,7,8-Pecdf	EPA 1613_1994	1
2,3,7,8-TCDD	EPA 1613_1994	1
2,3,7,8-TCDF	EPA 1613_1994	1
Hpcdd, total	EPA 1613_1994	1
Hpcdf, total	EPA 1613_1994	1
Hxcdd, total	EPA 1613_1994	1
Hxcdf, total	EPA 1613_1994	1
Pecdd, total	EPA 1613_1994	1
Pecdf, total	EPA 1613_1994	1
TCDD, total	EPA 1613_1994	1
TCDF, total	EPA 1613_1994	1
1,1,1,2-Tetrachloroethane	EPA 8260C SIM	1,2
1,1-Dichloroethylene	EPA 8260C SIM	1,2
1,2-Dichloroethane (Ethylene dichloride)	EPA 8260C SIM	1,2
Acrylonitrile	EPA 8260C SIM	1,2
Benzene	EPA 8260C SIM	1,2
cis-1,2-Dichloroethylene	EPA 8260C SIM	1,2
Tetrachloroethylene (Perchloroethylene)	EPA 8260C SIM	1,2
trans-1,2-Dichloroethylene	EPA 8260C SIM	1,2
Trichloroethene (Trichloroethylene)	EPA 8260C SIM	1,2
Vinyl chloride	EPA 8260C SIM	1,2
1,1,1,2-Tetrachloroethane	EPA 8260C_(8/06)	1
1,1,1-Trichloro-2,2,2-trifluoroethane	EPA 8260C_(8/06)	1

Matrix/Analyte	Method	Notes
1,1,1-Trichloroethane	EPA 8260C_(8/06)	1
1,1,2,2-Tetrachloroethane	EPA 8260C_(8/06)	1
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	EPA 8260C_(8/06)	1
1,1,2-Trichloroethane	EPA 8260C_(8/06)	1
1,1,2-Trichlorofluoroethane	EPA 8260C_(8/06)	1
1,1-Dichloroethane	EPA 8260C_(8/06)	1
1,1-Dichloroethylene	EPA 8260C_(8/06)	1
1,1-Dichloropropene	EPA 8260C_(8/06)	1
1,2,3-Trichlorobenzene	EPA 8260C_(8/06)	1
1,2,3-Trichloropropane	EPA 8260C_(8/06)	1
1,2,3-Trimethylbenzene	EPA 8260C_(8/06)	1
1,2,4-Trichlorobenzene	EPA 8260C_(8/06)	1
1,2,4-Trimethylbenzene	EPA 8260C_(8/06)	1
1,2-Dibromo-3-chloropropane (DBCP)	EPA 8260C_(8/06)	1
1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA 8260C_(8/06)	1
1,2-Dichlorobenzene	EPA 8260C_(8/06)	1
1,2-Dichloroethane (Ethylene dichloride)	EPA 8260C_(8/06)	1
1,2-Dichloropropane	EPA 8260C_(8/06)	1
1,3,5-Trimethylbenzene	EPA 8260C_(8/06)	1
1,3-Dichlorobenzene	EPA 8260C_(8/06)	1
1,3-Dichloropropane	EPA 8260C_(8/06)	1
1,3-Dichloropropene	EPA 8260C_(8/06)	1
1,4-Dichlorobenzene	EPA 8260C_(8/06)	1
1,4-Dioxane (1,4- Diethyleneoxide)	EPA 8260C_(8/06)	1
1-Chlorohexane	EPA 8260C_(8/06)	1
2,2-Dichloropropane	EPA 8260C_(8/06)	1
2,2'-Oxybis(1-chloropropane)	EPA 8260C_(8/06)	1
2,3-Dichloropropene	EPA 8260C_(8/06)	1
2-Bromofluorobenzene	EPA 8260C_(8/06)	1
2-Butanone (Methyl ethyl ketone, MEK)	EPA 8260C_(8/06)	1
2-Chloroethyl vinyl ether	EPA 8260C_(8/06)	1
2-Chlorotoluene	EPA 8260C_(8/06)	1
2-Hexanone	EPA 8260C_(8/06)	1
2-Pentanone	EPA 8260C_(8/06)	1
4-Bromofluorobenzene	EPA 8260C_(8/06)	1
4-Chlorotoluene	EPA 8260C_(8/06)	1

Matrix/Analyte	Method	Notes
4-Isopropyltoluene (p-Cymene)	EPA 8260C_(8/06)	1
4-Methyl-1-Pentene	EPA 8260C_(8/06)	1
4-Methyl-2-pentanone (MIBK)	EPA 8260C_(8/06)	1
Acetone	EPA 8260C_(8/06)	1
Acetonitrile	EPA 8260C_(8/06)	1
Acrolein (Propenal)	EPA 8260C_(8/06)	1
Acrylonitrile	EPA 8260C_(8/06)	1
Benzene	EPA 8260C_(8/06)	1
Bromobenzene	EPA 8260C_(8/06)	1
Bromochloromethane	EPA 8260C_(8/06)	1
Bromodichloromethane	EPA 8260C_(8/06)	1
Bromoethane (Ethyl Bromide)	EPA 8260C_(8/06)	1
Bromoform	EPA 8260C_(8/06)	1
Carbon disulfide	EPA 8260C_(8/06)	1
Carbon tetrachloride	EPA 8260C_(8/06)	1
Chlorobenzene	EPA 8260C_(8/06)	1
Chlorodibromomethane	EPA 8260C_(8/06)	1
Chloroethane (Ethyl chloride)	EPA 8260C_(8/06)	1
Chloroform	EPA 8260C_(8/06)	1
cis & trans-1,2-Dichloroethene	EPA 8260C_(8/06)	1
cis-1,2-Dichloroethylene	EPA 8260C_(8/06)	1
cis-1,3-Dichloropropene	EPA 8260C_(8/06)	1
Cyclohexane	EPA 8260C_(8/06)	1
Cyclohexanol	EPA 8260C_(8/06)	1
Cyclohexanone	EPA 8260C_(8/06)	1
Dibromofluoromethane	EPA 8260C_(8/06)	1
Dibromomethane	EPA 8260C_(8/06)	1
Dichlorodifluoromethane (Freon-12)	EPA 8260C_(8/06)	1
Dichlorofluoromethane (Freon 21)	EPA 8260C_(8/06)	1
Diethyl ether	EPA 8260C_(8/06)	1
Ethanol	EPA 8260C_(8/06)	1
Ethyl acetate	EPA 8260C_(8/06)	1
Ethylbenzene	EPA 8260C_(8/06)	1
Ethyl-t-butylether (ETBE)	EPA 8260C_(8/06)	1
Hexachlorobutadiene	EPA 8260C_(8/06)	1
Hexachloroethane	EPA 8260C_(8/06)	1

Matrix/Analyte	Method	Notes
Iodomethane (Methyl iodide)	EPA 8260C_(8/06)	1
Isobutyl alcohol (2-Methyl-1-propanol)	EPA 8260C_(8/06)	1
Isopropylbenzene	EPA 8260C_(8/06)	1
m+p-xylene	EPA 8260C_(8/06)	1
Methyl bromide (Bromomethane)	EPA 8260C_(8/06)	1
Methyl chloride (Chloromethane)	EPA 8260C_(8/06)	1
Methyl formate	EPA 8260C_(8/06)	1
Methyl methacrylate	EPA 8260C_(8/06)	1
Methyl tert-butyl ether (MTBE)	EPA 8260C_(8/06)	1
Methylcyclohexane	EPA 8260C_(8/06)	1
Methylene chloride (Dichloromethane)	EPA 8260C_(8/06)	1
m-Xylene	EPA 8260C_(8/06)	1
Naphthalene	EPA 8260C_(8/06)	1
n-Butylbenzene	EPA 8260C_(8/06)	1
n-Hexane	EPA 8260C_(8/06)	1
n-Propylbenzene	EPA 8260C_(8/06)	1
o-Xylene	EPA 8260C_(8/06)	1
p-Xylene	EPA 8260C_(8/06)	1
sec-Butylbenzene	EPA 8260C_(8/06)	1
Styrene	EPA 8260C_(8/06)	1
tert-Amyl alcohol (TAA)	EPA 8260C_(8/06)	1
tert-Amyl ethyl ether (TAEE)	EPA 8260C_(8/06)	1
tert-amylmethylether (TAME)	EPA 8260C_(8/06)	1
tert-Butyl alcohol	EPA 8260C_(8/06)	1
tert-Butylbenzene	EPA 8260C_(8/06)	1
Tetrachloroethylene (Perchloroethylene)	EPA 8260C_(8/06)	1
Toluene	EPA 8260C_(8/06)	1
trans-1,2-Dichloroethylene	EPA 8260C_(8/06)	1
trans-1,3-Dichloropropylene	EPA 8260C_(8/06)	1
trans-1,4-Dichloro-2-butene	EPA 8260C_(8/06)	1
Trichloroethene (Trichloroethylene)	EPA 8260C_(8/06)	1
Trichlorofluoromethane (Freon 11)	EPA 8260C_(8/06)	1
Vinyl acetate	EPA 8260C_(8/06)	1
Vinyl chloride	EPA 8260C_(8/06)	1
Xylene (total)	EPA 8260C_(8/06)	1
1,2,4,5-Tetrachlorobenzene	EPA 8270D_(2/07)	1

Matrix/Analyte	Method	Notes
1,2,4-Trichlorobenzene	EPA 8270D_(2/07)	1
1,2-Dibromo-3-chloropropane (DBCP)	EPA 8270D_(2/07)	1
1,2-Dichlorobenzene	EPA 8270D_(2/07)	1
1,2-Diphenylhydrazine	EPA 8270D_(2/07)	1
1,3-Dichlorobenzene	EPA 8270D_(2/07)	1
1,4-Dichlorobenzene	EPA 8270D_(2/07)	1
1,4-Dioxane (1,4- Diethyleneoxide)	EPA 8270D_(2/07)	1
12-Chlorodehydroabietic Acid	EPA 8270D_(2/07)	1
14-Chlorodehydroabietic Acid	EPA 8270D_(2/07)	1
1-Chloronaphthalene	EPA 8270D_(2/07)	1
1-Methylnaphthalene	EPA 8270D_(2/07)	1
2,3,4,6-Tetrachlorophenol	EPA 8270D_(2/07)	1
2,4,5-Trichlorophenol	EPA 8270D_(2/07)	1
2,4,5-Trimethylaniline	EPA 8270D_(2/07)	1
2,4,6-Trichlorophenol	EPA 8270D_(2/07)	1
2,4-Dichlorophenol	EPA 8270D_(2/07)	1
2,4-Dimethylphenol	EPA 8270D_(2/07)	1
2,4-Dinitrophenol	EPA 8270D_(2/07)	1
2,4-Dinitrotoluene (2,4-DNT)	EPA 8270D_(2/07)	1
2,6-Dichlorophenol	EPA 8270D_(2/07)	1
2,6-Dinitrotoluene (2,6-DNT)	EPA 8270D_(2/07)	1
2-Benzyl-4-chlorophenol	EPA 8270D_(2/07)	1
2-Chloronaphthalene	EPA 8270D_(2/07)	1
2-Chlorophenol	EPA 8270D_(2/07)	1
2-Methoxyphenol (Guaiacol)	EPA 8270D_(2/07)	1
2-Methylnaphthalene	EPA 8270D_(2/07)	1
2-Methylphenol (o-Cresol)	EPA 8270D_(2/07)	1
2-Nitroaniline	EPA 8270D_(2/07)	1
2-Nitrophenol	EPA 8270D_(2/07)	1
3,3'-Dichlorobenzidine	EPA 8270D_(2/07)	1
3,4,5-Trichloroguaiacol	EPA 8270D_(2/07)	1
3,4,6-Trichloroguaiacol	EPA 8270D_(2/07)	1
3,4-Dichloroguaiacol	EPA 8270D_(2/07)	1
3-Methylcholanthrene	EPA 8270D_(2/07)	1
3-Methylphenol (m-Cresol)	EPA 8270D_(2/07)	1
3-Nitroaniline	EPA 8270D_(2/07)	1

Matrix/Analyte	Method	Notes
4,5,6-Trichloroguaiacol	EPA 8270D_(2/07)	1
4,5-Dichloroguaiacol	EPA 8270D_(2/07)	1
4,6-Dichloroguaiacol	EPA 8270D_(2/07)	1
4,6-Dinitro-2-methylphenol	EPA 8270D_(2/07)	1
4-Bromophenyl phenyl ether (BDE-3)	EPA 8270D_(2/07)	1
4-Chloro-3-methylphenol	EPA 8270D_(2/07)	1
4-Chloroaniline	EPA 8270D_(2/07)	1
4-Chloroguaiacol	EPA 8270D_(2/07)	1
4-Chlorophenol	EPA 8270D_(2/07)	1
4-Methylphenol (p-Cresol)	EPA 8270D_(2/07)	1
4-Nitroaniline	EPA 8270D_(2/07)	1
4-Nitrophenol	EPA 8270D_(2/07)	1
7,12-Dimethylbenz(a) anthracene	EPA 8270D_(2/07)	1
9,10-Dichlorostearic Acid	EPA 8270D_(2/07)	1
Abietic Acid	EPA 8270D_(2/07)	1
Acenaphthene	EPA 8270D_(2/07)	1
Acenaphthylene	EPA 8270D_(2/07)	1
Acetophenone	EPA 8270D_(2/07)	1
Acetophenone	EPA 8270D_(2/07)	1
alpha-Terpineol	EPA 8270D_(2/07)	1
Aniline	EPA 8270D_(2/07)	1
Anthracene	EPA 8270D_(2/07)	1
Benzidine	EPA 8270D_(2/07)	1
Benzo(a)anthracene	EPA 8270D_(2/07)	1
Benzo(a)pyrene	EPA 8270D_(2/07)	1
Benzo(g,h,i)perylene	EPA 8270D_(2/07)	1
Benzo(j)fluoranthene	EPA 8270D_(2/07)	1
Benzo(k)fluoranthene	EPA 8270D_(2/07)	1
Benzo[b]fluoranthene	EPA 8270D_(2/07)	1
Benzoic acid	EPA 8270D_(2/07)	1
Benzyl alcohol	EPA 8270D_(2/07)	1
Biphenyl	EPA 8270D_(2/07)	1
bis(2-Chloroethoxy)methane	EPA 8270D_(2/07)	1
bis(2-Chloroethyl) ether	EPA 8270D_(2/07)	1
bis(2-Chloroisopropyl) ether	EPA 8270D_(2/07)	1
Butyl benzyl phthalate	EPA 8270D_(2/07)	1

Matrix/Analyte	Method	Notes
Butyl diphenyl Phosphate	EPA 8270D_(2/07)	1
Butylated Hydroxytoluene	EPA 8270D_(2/07)	1
Butyl-tin Species	EPA 8270D_(2/07)	1
Carbaryl (Sevin)	EPA 8270D_(2/07)	1
Carbazole	EPA 8270D_(2/07)	1
Chrysene	EPA 8270D_(2/07)	1
Dehydroabietic Acid	EPA 8270D_(2/07)	1
Di(2-ethylhexyl)phthalate	EPA 8270D_(2/07)	1
Dibenz(a,h) acridine	EPA 8270D_(2/07)	1
Dibenz(a,h) anthracene	EPA 8270D_(2/07)	1
Dibenz(a,j) acridine	EPA 8270D_(2/07)	1
Dibenzo(a,e) pyrene	EPA 8270D_(2/07)	1
Dibenzofuran	EPA 8270D_(2/07)	1
Dibutyl phenyl Phospahate	EPA 8270D_(2/07)	1
Dichlorodehydroabietic Acid	EPA 8270D_(2/07)	1
Diethyl phthalate	EPA 8270D_(2/07)	1
Dimethyl phthalate	EPA 8270D_(2/07)	1
Di-n-butyl phthalate	EPA 8270D_(2/07)	1
Di-n-octyl phthalate	EPA 8270D_(2/07)	1
Diphenyl ether	EPA 8270D_(2/07)	1
Fluoranthene	EPA 8270D_(2/07)	1
Fluorene	EPA 8270D_(2/07)	1
Hexachlorobenzene	EPA 8270D_(2/07)	1
Hexachlorobutadiene	EPA 8270D_(2/07)	1
Hexachlorocyclopentadiene	EPA 8270D_(2/07)	1
Hexachloroethane	EPA 8270D_(2/07)	1
Indeno(1,2,3-cd) pyrene	EPA 8270D_(2/07)	1
Isophorone	EPA 8270D_(2/07)	1
Isopimaric Acid	EPA 8270D_(2/07)	1
Linoleic Acid	EPA 8270D_(2/07)	1
Mirex	EPA 8270D_(2/07)	1
Naphthalene	EPA 8270D_(2/07)	1
Neoabietic Acid	EPA 8270D_(2/07)	1
n-Hexadecane	EPA 8270D_(2/07)	1
Nicotine	EPA 8270D_(2/07)	1
Nitrobenzene	EPA 8270D_(2/07)	1

Matrix/Analyte	Method	Notes
N-Nitrosodiethylamine	EPA 8270D_(2/07)	1
N-Nitrosodimethylamine	EPA 8270D_(2/07)	1
N-Nitroso-di-n-butylamine	EPA 8270D_(2/07)	1
N-Nitroso-di-n-propylamine	EPA 8270D_(2/07)	1
N-Nitrosodiphenylamine	EPA 8270D_(2/07)	1
n-Tetradecane	EPA 8270D_(2/07)	1
o,o,o-Triethyl phosphorothioate	EPA 8270D_(2/07)	1
Oleic Acid	EPA 8270D_(2/07)	1
Palustric Acid	EPA 8270D_(2/07)	1
p-Benzoquinone	EPA 8270D_(2/07)	1
Pentachlorobenzene	EPA 8270D_(2/07)	1
Pentachlorophenol	EPA 8270D_(2/07)	1
Perylene	EPA 8270D_(2/07)	1
Phenanthrene	EPA 8270D_(2/07)	1
Phenol	EPA 8270D_(2/07)	1
Pimaric Acid	EPA 8270D_(2/07)	1
Pyrene	EPA 8270D_(2/07)	1
Pyridine	EPA 8270D_(2/07)	1
Retene	EPA 8270D_(2/07)	1
Sandaraopimaric Acid	EPA 8270D_(2/07)	1
Tetrachloroguaiacol	EPA 8270D_(2/07)	1
Toxaphene (Chlorinated camphene)	EPA 8270D_(2/07)	1
Tributyl phosphate	EPA 8270D_(2/07)	1
Trifluralin (Treflan)	EPA 8270D_(2/07)	1
Trimethyl phosphate	EPA 8270D_(2/07)	1
Triphenyl phosphate	EPA 8270D_(2/07)	1
1-Methylnaphthalene	EPA 8270D_(2/07) SIM	1,2
Acenaphthene	EPA 8270D_(2/07) SIM	1,2
Acenaphthylene	EPA 8270D_(2/07) SIM	1,2
Anthracene	EPA 8270D_(2/07) SIM	1,2
Atrazine	EPA 8270D_(2/07) SIM	1,2
Azinphos-ethyl (Ethyl guthion)	EPA 8270D_(2/07) SIM	1,2
Azinphos-methyl (Guthion)	EPA 8270D_(2/07) SIM	1,2
Benzo(a)anthracene	EPA 8270D_(2/07) SIM	1,2
Benzo(a)pyrene	EPA 8270D_(2/07) SIM	1,2
Benzo(g,h,i)perylene	EPA 8270D_(2/07) SIM	1,2

Matrix/Analyte	Method	Notes
Benzo(j)fluoranthene	EPA 8270D_(2/07) SIM	1,2
Benzo(k)fluoranthene	EPA 8270D_(2/07) SIM	1,2
Benzo[b]fluoranthene	EPA 8270D_(2/07) SIM	1,2
Bolstar (Sulprofos)	EPA 8270D_(2/07) SIM	1,2
Chlorfenvinphos	EPA 8270D_(2/07) SIM	1,2
Chlorpyrifos	EPA 8270D_(2/07) SIM	1,2
Chrysene	EPA 8270D_(2/07) SIM	1,2
Coumaphos	EPA 8270D_(2/07) SIM	1,2
Crotoxyphos	EPA 8270D_(2/07) SIM	1,2
Demeton	EPA 8270D_(2/07) SIM	1,2
Demeton-o	EPA 8270D_(2/07) SIM	1,2
Demeton-s	EPA 8270D_(2/07) SIM	1,2
Diazinon	EPA 8270D_(2/07) SIM	1,2
Dibenz(a,h) anthracene	EPA 8270D_(2/07) SIM	1,2
Dichlorofenthion	EPA 8270D_(2/07) SIM	1,2
Dichlorovos (DDVP, Dichlorvos)	EPA 8270D_(2/07) SIM	1,2
Dicrotophos	EPA 8270D_(2/07) SIM	1,2
Dimethoate	EPA 8270D_(2/07) SIM	1,2
Dioxathion	EPA 8270D_(2/07) SIM	1,2
Disulfoton	EPA 8270D_(2/07) SIM	1,2
EPN	EPA 8270D_(2/07) SIM	1,2
Ethion	EPA 8270D_(2/07) SIM	1,2
Ethoprop	EPA 8270D_(2/07) SIM	1,2
Famphur	EPA 8270D_(2/07) SIM	1,2
Fenitrothion	EPA 8270D_(2/07) SIM	1,2
Fensulfothion	EPA 8270D_(2/07) SIM	1,2
Fenthion	EPA 8270D_(2/07) SIM	1,2
Fluoranthene	EPA 8270D_(2/07) SIM	1,2
Fluorene	EPA 8270D_(2/07) SIM	1,2
Indeno(1,2,3-cd) pyrene	EPA 8270D_(2/07) SIM	1,2
Malathion	EPA 8270D_(2/07) SIM	1,2
Merphos	EPA 8270D_(2/07) SIM	1,2
Methyl parathion (Parathion, methyl)	EPA 8270D_(2/07) SIM	1,2
Mevinphos	EPA 8270D_(2/07) SIM	1,2
Naled	EPA 8270D_(2/07) SIM	1,2
Naphthalene	EPA 8270D_(2/07) SIM	1,2

Matrix/Analyte	Method	Notes
Parathion	EPA 8270D_(2/07) SIM	1,2
Parathion, ethyl	EPA 8270D_(2/07) SIM	1,2
Pentachlorophenol	EPA 8270D_(2/07) SIM	1,2
Phenanthrene	EPA 8270D_(2/07) SIM	1,2
Phorate	EPA 8270D_(2/07) SIM	1,2
Pyrene	EPA 8270D_(2/07) SIM	1,2
Ronnel	EPA 8270D_(2/07) SIM	1,2
Sulfotepp	EPA 8270D_(2/07) SIM	1,2
Tetrachlorvinphos (Stirophos, Gardona)	EPA 8270D_(2/07) SIM	1,2
Tokuthion (Prothiophos)	EPA 8270D_(2/07) SIM	1,2
Trichloronate	EPA 8270D_(2/07) SIM	1,2
Tri-o-cresylphosphate (TOCP)	EPA 8270D_(2/07) SIM	1,2
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	EPA 8290A_(1/98)	1
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	EPA 8290A_(1/98)	1
1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7	EPA 8290A_(1/98)	1
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4'	EPA 8290A_(1/98)	1
1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8	EPA 8290A_(1/98)	1
1,2,3,4,7,8-Hxcdd	EPA 8290A_(1/98)	1
1,2,3,4,7,8-Hxcdf	EPA 8290A_(1/98)	1
1,2,3,6,7,8-Hxcdd	EPA 8290A_(1/98)	1
1,2,3,6,7,8-Hxcdf	EPA 8290A_(1/98)	1
1,2,3,7,8,9-Hxcdd	EPA 8290A_(1/98)	1
1,2,3,7,8,9-Hxcdf	EPA 8290A_(1/98)	1
1,2,3,7,8-Pecdd	EPA 8290A_(1/98)	1
1,2,3,7,8-Pecdf	EPA 8290A_(1/98)	1
2,3,4,6,7,8-Hxcdf	EPA 8290A_(1/98)	1
2,3,4,7,8-Pecdf	EPA 8290A_(1/98)	1
2,3,7,8-TCDD	EPA 8290A_(1/98)	1
2,3,7,8-TCDF	EPA 8290A_(1/98)	1
Hpcdd, total	EPA 8290A_(1/98)	1
Hpcdf, total	EPA 8290A_(1/98)	1
Hxcdd, total	EPA 8290A_(1/98)	1
Hxcdf, total	EPA 8290A_(1/98)	1
Pecdd, total	EPA 8290A_(1/98)	1
Pecdf, total	EPA 8290A_(1/98)	1
TCDD, total	EPA 8290A_(1/98)	1

Matrix/Analyte	Method	Notes
TCDF, total	EPA 8290A_(1/98)	1
Particle Size Distribution	ASTM D422-63 (07)	
Corrosivity	EPA 9040C_2002	1
Particle Size Distribution	PSEP 1986 Wet Sieve	

Accredited Parameter Note Detail

(1) Recognition of Oregon NELAP accreditation. (2) GC-MS Selective Ion Monitoring (SIM). (3) Washington Department of Ecology Analytical Methods for Petroleum Hydrocarbons, Publication Number ECY 97-602, June 1997. (4) ARI SOP for Water Soluble Non-halogenated Volatile and Semivolatile Organic Compounds, including glycols. (5) Provisional accreditation pending submittal of additional, acceptable Proficiency Testing (PT) results (WAC 173-50-110). (6) Includes capability for low levels in aqueous samples using a modified hexane extraction. (7) Includes Low-Level Pesticides by ARI SOP 710S. (8) Approved for compliance testing only when holding time is met. (9) Includes gasoline analysis by GCMS EPA 8260C. (10) Accreditation based in part on recognition of DoD-ELAP accreditation.

07/08/2014

Authentication Signature
Alan D. Rue, Lab Accreditation Unit Supervisor

Date